JPRS 82086

27 October 1982

China Report

ECONOMIC AFFAIRS

No. 276

ENERGY: STATUS AND DEVELOPMENT -- X

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS 82086

27 October 1982

CHINA REPORT
ECONOMIC AFFAIRS

No. 276

ENERGY: STATUS AND DEVELOPMENT -- X

CONTENTS

NATIONAL POLICY

Efforts To Increase Energy Production Reviewed
(XINHUA, 19 Aug 82)..... 1

POWER NETWORK

Expansion of National Power Grid Construction
(RENMIN RIBAO, 22 Sep 82)..... 3

Accelerating Development of National Power Grid
(Huang Xi; GUANGMING RIBAO, 3 Sep 82)..... 4

Work Stepped Up on Taizhou Thermal Power Plant
(ZHEJIANG RIBAO, 4 Sep 82)..... 7

Work Progresses on Fujian's Biggest Thermal Power Plant
(FUJIAN RIBAO, 7 Jun 82)..... 9

Thermal Power Plant To Be Built at Shidongkou, Baoshan County
(WENHUI BAO, 15 May 82)..... 10

Baoding Transformer Plant Now Producing 500KV Ultrahigh-Tension Equipment
(HEBEI HUABAO, 1982)..... 11

Symposium on Power System Planning Held in Nanning
(DIANLI JISHU, 5 Jul 82)..... 13

[III - CC - 83]

Malfunctions in 110-Kilovolt Transformers Analyzed
(Lin Min; DIANLI JISHU, 5 Jun 82)..... 15

Analysis of Loss of Stability in Some Grids
(DIANLI JISHU, 5 Jun 82)..... 21

Serious Drought Forces Yunnan To Institute Electric Power Economy
(Kunming Yunnan Provincial Service, 24 Jul 82)..... 29

Different Types of High-Tension Circuit Breakers Described
(Cao Rongjiang, Gu Nihong; DIANSHIJIE, 1982)..... 31

Increase Reported in Fujian's Electric Power Output
(FUJIAN RIBAO, 2 Jul 82)..... 42

Briefs
New Submarine Power Cable 44
Water-Cooled Turbine 44
Electricity Output 45
Gansu Reports Record Power Output 45
Hunan Power Industry 46
Nei Monggol Power Supply 46
Heilongjiang Power Output 46
Jilin Electricity 46
Shandong Power Plants 47
Shandong Power for Agriculture 47
Guizhou Increases Electricity Output 47
Shandong Power Station 47
Gansu Power Output 47
Henan Electricity Output 48
Guangdong Power Output 48
Jilin Power Industry 48
Qinling Thermal Power Plant 48
Ningxia Thermal Power Plant 48
330,000 Volt Transmission Line 49

HYDROPOWER

Conference Focuses on Ways To Accelerate Hydropower Construction
(SHUILI FADIAN, 12 Jul 82)..... 50

Ways To Shorten Construction Time for Large Projects Examined
(Liao Canyue; SHUILI FADIAN, 12 May 82)..... 53

Big 630,000-KW Hydropower Station on the Wujiang Nears Completion
(RENMIN RIBAO, 20 Aug 82)..... 61

Status Report on Wujiangdu, Ankang Hydroelectric Projects
(Zhang Jihua; SHUILI FADIAN, 12 May 82)..... 62

Status Report on Taipingshao, Jinshuitan Hydroelectric Projects
(Zhang Jihua; SHUILI FADIAN, 12 Jun 82)..... 66

Economic Efficiency of Small-Scale Hydropower in Shantou Prefecture Analyzed
(Chen Haojiu; NENG YUAN, 25 Jun 82)..... 69

Development of Small-Scale Hydropower in Guangze County, Fujian Province
(RENMIN RIBAO, 21 Jun 82)..... 76

Yangshan Shui: A Small-Scale Cascade Hydropower Project
(Gan Zhangcheng; SHUILI SHUIDIAN JISHU, 20 Jun 82)..... 77

Advantages of Mini-Hydropower Stations Pointed Out
(Gan Zhangcheng; XIN NENG YUAN, 5 Apr 82)..... 83

Small-Scale Power Stations Proliferate
(DIANSHIJIE, Mar 82)..... 90

Selection of Main Transformers for Small-Scale Rural Hydropower Stations
(Qing Yongkang; SHUILI SHUIDIAN JISHU, 20 May 82)..... 92

Small-Scale Hydropower Projects Add 2.48 Million KW in Installed Capacity in Three Years
(RENMIN RIBAO, 14 Aug 82)..... 97

New Series of Generators for Small-Scale Hydropower Stations Needed
(Wang Lan; SHUILI SHUIDIAN JISHU, 20 Jun 82)..... 99

Briefs
Yunnan Small-Scale Hydropower 101
Gansu Small-Scale Hydropower 101

COAL

China's Coal Output To Double By Year 2000
(BEIJING REVIEW, 11 Oct 82)..... 102

PRC Vice Minister Views Coal Industry's Future
(CHINA DAILY, 5 Aug 82)..... 104

Giant Coal Center in East China Under Rapid Construction
(Wu Zhixiang; SHIJIE MEITAN KEXUE, 12 Jul 82)..... 105

New Rail Links, Slurry Pipelines Under Study for Shanxi Coal Base
(Hu Guangrong; NENG YUAN, 25 Jun 82)..... 114

Academy of Sciences Helping To Plan Coal Slurry Project For Shanxi
(XINHUA Domestic Service, 11 Aug 82)..... 119

Shanxi Exceeds Coal Report Plan for First Half of 1982
(SHANXI RIBAO, 4 Jul 82)..... 120

New Mines Approved for Anhui Coal Center
(XINHUA, 30 Sep 82)..... 121

Datong Daily Coal Production Now Over 70,000 Tons
(Li Bacheng, Yang Xiaoning; SHANXI RIBAO, 30 Apr 82)..... 122

New Plant Is Nation's First To Produce Coal Gas From Lignite
(RENMIN RIBAO, 26 Jul 82)..... 124

Prospects for Coal-Bed Methane Resources Explored
(Wang Chijie, Feng Tianyuan; MEITAN KEXUE JISHU, 25 Jun 82) 125

Problems Concerning the Development of Gas in Coal Fields
(Li Yingjin; NENG YUAN, 25 Jun 82)..... 129

Ways To Develop Coal Ash Resources Examined
(DIANLI JISHU, 5 Jul 82)..... 135

Briefs
Xishan Increased Coal Output 138
Oil to Coal Conversion 138
Heilongjiang Collieries
Anhui Coal Center

OIL AND GAS

How To Use Nation's Predicted Output of 100 Million Tons of Crude Per Year Is Subject of Serious Concern
(Zheng Bingqiang; NENG YUAN, 25 Jun 82)..... 141

Guangdong: More Successes in Prospecting for Offshore Oil
(Guangdong Provincial Service, 5 Sep 82)..... 147

Daqing Gets Good Results From Water Injection
(XINHUA, 10 Sep 82)..... 148

Sichuan Surpasses Mid-Year Coal for Oil Production
(SICHUAN RIBAO, 20 Jun 82)..... 149

PRC Oil Drilling Equipment Meets World Standards
(XINHUA, 13 Sep 82)..... 150

Some Problems in Recent Development in Geophysical Prospecting for Petroleum
(Chen Lusheng; SHIYOU WUTAN, Jun 82)..... 151

Tectonic Framework, Possibilities of Oil in Mesozoic Rocks of Bohai Bay
(Hu Jianyi, et al.; SHIYOU XUEBAO, Apr 82)..... 158

Briefs
Dalian Shipyard Builds Rigs 173
Xinjiang Oilfield Output 173
Beijing High-Yield Gas Well 173
Oil Production Target 174
New Oil Reserves Uncovered 174
East China Natural Gas 174
East Sea Oil Well 174
Tiandong Oilfield Production 174
Hunan Kerosene Shortage 175
Heilongjiang Daqing Oilfield 175
Shandong Hydrogenation Equipment 175

SUPPLEMENTAL SOURCES

Zhejiang's Potential for Tidal Power
(Chen Yafei; ZHEJIANG RIBAO, 8 Jun 82)..... 176

Jiangxia Experimental Tidal Power Station
(Lu Fengyang; XIN NENG YUAN, 5 Jun 82)..... 179

Ways Suggested To Alleviate Critical Rural Energy Shortage
(Deng Keyun; XIANDAIHUA, 16 Jul 82)..... 185

Exploitation and Utilization of Geothermal Energy in China
(Wang Dachun; GUANGUO DIRE XUESHU HUIYI LUNWEN XUANJI, Oct 81)..... 190

Briefs
Methane Generator 197
Geothermal Power Plant 197

CONSERVATION

'RENMIN RIBAO' on Shanghai Energy Conservation
(Yao Xitang, Jin Xingren; RENMIN RIBAO, 20 Sep 82)..... 198

Zhejiang Party Committee, Government Issue Specific Requirements for Energy Conservation
(Fu Cong; ZHEJIANG RIBAO, 8 Jul 82)..... 202

Major Energy Consumers Urged To Lead Energy Conservation
(ZHEJIANG RIBAO, 5 Jul 82)..... 204

Bigger Fines Suggested for Failure to Lower Energy Consumption
(ZHEJIANG RIBAO, 5 Jul 82)..... 206

Criticized, Enterprises Reduce Energy Consumption
(ZHEJIANG RIBAO, 5 Jul 82)..... 208

Economic, Pollution Considerations of Gasoline-Methanol Mixtures Explored
(XIN NENG YUAN, 5 May 82)..... 210

NATIONAL POLICY

EFFORTS TO INCREASE ENERGY PRODUCTION REVIEWED

OW202058 Beijing XINHUA in English 0749 GMT 19 Aug 82

[Text] Beijing, August 19 (XINHUA)--China's energy output rose 7.2 percent in the first seven months of this year over the same 1981 period, equivalent to 377 million tons of standard coal. Production of coal, which accounts for 70 percent of all China's energy output, rose 9.6 percent in the same period.

The State Statistical Bureau reports that China put over 21 percent of its capital construction investment into energy development between 1979 and 1981 and in the first half of 1982.

Currently under construction are 66 large and medium-sized coal mining areas with a total capacity of 100 million tons and 62 hydroelectric and thermal power stations totaling more than 20 million kilowatts.

Of the key coal mining projects now under construction the biggest are five mining areas in Shanxi, Anhui, Shandong and Inner Mongolia, each having a designed capacity of over 10 million tons. Most of the new mines of these mining areas are expected to go into production by the end of 1985. Smaller ones under construction spread in Gansu, Shaanxi, Henan, Heilongjiang, Hebei, Jiangsu and other provinces. Ten major hydroelectric and thermal power stations are under construction. Most of them have a designed capacity of over 500,000 kilowatts.

For a fairly long period to come, a spokesman for the State Planning Commission said, China will continue to give priority to the development of coal and hydropower, taking coal as the major source of energy. Special efforts will be devoted to raising the percentage of hydropower in the production of primary energy, as China ranks first in the world in terms of water power resources.

China has also stepped up its exploration and development of petroleum resources, and is planning nuclear power stations for some energy-short areas.

While making efforts to expand its energy industry, the country has launched a nationwide energy conservation drive, which enabled China to increase its total industrial output value at an average annual rate of 7.1 percent over the past three years.

According to the State Statistical Bureau, China has saved 61 million tons of standard coal in the past two years, 26 million tons of them in 1981. Of these savings, 41 million tons was the result of the drive to restrict some branches of heavy industry and refurbish or close inefficient small industrial enterprises. Shandong Province alone is reported to have saved 600,000 tons of coal through closing small inefficient blast furnaces, chemical fertilizer plants and power stations.

Other conservation measures included renovation and replacement of inefficient boilers, pumps, blowers, transformers, motors and vehicles. Recently, the State Council decided to start rationing coal for industrial boilers from 1983 in an effort to further promote renovation and replacement of aging equipment.

CSO: 4010/7

PUBLIC WORKS

EXPANSION OF NATIONAL POWER GRID CONSTRUCTION

Beijing RENMIN RIBAO in Chinese 22 Sep 82 p 3

[Text] In the last 3 years, China's power grid has undergone new expansion, with some 17,400 kilometers of transmission lines of 110,000 volts or more being added. This translates into 20 percent of all such lines built in the last 24 years.

In recent years, along with the expansion of the power grid, China has built (or is in the process of building) a number of 500,000-volt extra-high tension transmission and transformer projects. The Northeast Power Grid is in the process of constructing a 500,000-volt power transmission line from the Yuanbaoshan power plant in the Nei Monggol coal base to Liaoyang. This line has a total length of 620 kilometers. After the entire line has been completed, the Yuanbaoshan power plant will supply electricity to industry of central and southern Liaoning. The North China Power Grid is now building a 500,000-volt extra-high tension line from the power plant in the coal region of Shuoxian, Datong, Shanxi Province, to Beijing and Tianjin. This line stretches over the Taihang Mountains for a total length of more than 300 kilometers. A great artery of the North China Power Grid, it will properly regulate the electric power industry distribution in that region.

In the East China Power Grid, the 220,000-volt high-tension line from Xiaoshan in Zhejiang Province to Changzhou in Jiangsu Province is already operational. This line has a total length of 204 kilometers and represents a further step toward the completion of the East China Power Grid. It will play an important role in coordinating the hydropower of Zhejiang with the thermal power of Jiangsu.

In order to coordinate the hydropower of Hebei with the thermal power of Henan, the Central China Power Grid has built what is currently the longest and biggest high tension transmission and transformer complex in China--the Ping-Wu (Pingdingshan-Wuchang) line. This line, which crosses both the Chang Jiang and the Han Shui, has a total length of 600 kilometers. It will soon have a transmission capacity of 500,000 kilowatts to be further increased to 1 million kilowatts in the future.

CSO: 4013/11

ACCELERATING DEVELOPMENT OF NATIONAL POWER GRID

Beijing CHANGMING RIBAO in Chinese 3 Sep 82 p 2

[Article by Huang Xi [7806 2522], senior engineer, Ministry of Water Conservancy and Electric Power: "Accelerating the Connecting of Power Grids To Promote Economic Benefit"]

[Text] The development of the electric power industry in China has been very rapid. From 1949 to 1981 the electric power generating installed capacity increased more than 57-fold and the electric power generation increased more than 70-fold, moving from 23d place in the world to 6th place. In the early days after the establishment of the nation, there were only two power grids of not so big capacity in China consisting of the Northeast and the Beijing-Tianjin-Tangshan grids, and a transmission line of more than 110,000 volts existed only in the Northeast grid. Today, there are five interprovincial (district) electric power grids, including East China, the Northeast, Central China, Beijing-Tianjin-Tangshan, and Shaanxi-Gansu-Ningxia, covering all the provinces and districts except Tibet. By the end of 1981, there was a total of 13 power grids having a capacity of more than 1 million kW. Last year, the three power grids of Beijing-Tianjin-Tangshan, Shihan, and Shanxi were interconnected. As a result, its installed capacity reached 8.82 million kW and thus became the second largest power grid in China next only to the Northeast power grid.

For more than 2 decades, the electric power grids of the world's industrialized advanced nations became bigger and bigger with the development of the electric power industry and also due to the connection of grids. In Britain, France and Italy, the national power grids were formed first, then they were connected internationally. Eleven West European nations, seven East European nations, and four Scandanavian nations have realized international integrated power grids and exchange electric power mutually. The Soviet Union's nine Eurasian district power grids have been connected, resulting in a total installed capacity of 22.7 million kW. In the United States, 570 million kW of electric power generating facilities are operating in parallel and preparation is underway to connect the east and the west power grids using ultrahigh voltage DC transmission. It can be seen from this that connecting power grids has fast become a trend in the development of the world's electric power industry, an important technological policy for the development of the electric power industry and an important index for the modernization of the electric power industry.

The world's industrially developed nations are aggressively expanding their interconnecting power grids through continuously expanding technologies related to generator construction, ultrahigh voltage transmission and electric power grids, because the interconnecting power grids have outstanding technical and economic advantages. For example, a highly efficient large-scale generator having a low unit construction cost can be employed in a large-scale power plant and thus achieve savings in investment and fuel, lowering the generating cost, and reducing the assembly's spare capacity. The time difference and the seasonal difference over a large area can be utilized to suppress the peak load and thus improve the utilization rate of the power generating facilities. The technical and economic characteristics of the different types of facilities can be fully utilized and thus realize much better economic effect. The thermoelectric and hydroelectric power generating plants can be combined in a large electric power grid to achieve a regulating effect provided by the hydroelectric and thermoelectric power generation as well as the regulating effect provided by interconnecting a number of river basins. The capacity to cope with accidents can be strengthened and thus improve the reliability of electric power supply. A large surge load capacity can be absorbed more easily and thus improve the quality of electricity.

The electric power can be exchanged between different parts of the grid, transferring the electric power from a grid with excess to a grid with shortage. To be sure, there are also safety and reliability problems brought about by interconnection of power grids. However, these problems can be solved through adoption of advanced technological measures and strengthening of the operational management.

It can be seen from this that aggressively developing power grid technology and accelerating the interconnection of adjacent electric power grids in order to take full advantage of the economic effect of interconnected power grids ought to be one of the important technological policies for the realization of China's electric power industry modernization.

We must first of all raise the awareness of the importance of interconnecting power grids. In drafting plans for China's electric power development and in carrying out the electric power grid design of each province (district), we must have an idea of the overall situation. In selecting sites for the electric power sources and the plan for the electric power grid construction, and deciding the priority of construction investment, not only an overall balance within a province (district) but also the technical and economical effects of the interconnected power grid must be taken into consideration in order to arrive at an optimum design.

Secondly, we must aggressively undertake the research work related to the technology of ultrahigh voltage, large power transmission. Although China has rich energy resources they are very unevenly distributed. Hydropower resources are concentrated in the southwest, northwest, and south-central regions. Coal resources are concentrated in Shanxi, Nei Monggol, and Henan, while the electric power load is mainly in the eastern districts along the coast where there is a shortage of energy resources. Therefore, development of ultra (very) high voltage DC and AC electric power transmission technologies is urgently needed.

China's first 500,000-volt ultrahigh voltage transmission line running from Pingdingshan to Wuchang (754 km) was put into operation last year. From now on, we must undertake the research work related to the development of an even higher voltage (750,000-100,000,000-volt) AC power transmission technology. The DC power transmission is a technology with a great future. Therefore, both DC and AC power transmission technologies must complement one another in the large-scale power grids or interconnected power grids which are to be built in China in the future. Neither technology may be neglected.

Finally, we must also research and formulate regulations and technical measures to guarantee the quality of electricity of the power grid. We must also research and solve the problems related to the safety and reliability of the expanded power grid and the interconnected power grids. The fundamental technological measures that can be used to guarantee the voltage of the electric power grid include powerless power source and voltage regulation. The fundamental technological measures that must be introduced to China's ever-expanding electric power grid in order to guarantee the operational safety include such technologies as highspeed switch, highspeed excitation control, electric brake, and series capacitor compensator.

9113
CSO: 4013/168

POWER NETWORK

WORK STEPPED UP ON TAIZHOU THERMAL POWER PLANT

Hangzhou ZHEJIANG RIBAO in Chinese 4 Sep 82 p 2

[Text] In building the Taizhou Power Plant, the cadres, workers, engineers, and technicians are using new methods, technology and materials to achieve notable improvements in engineering quality and a greatly accelerated pace of construction. Construction now centers on the installation of the machinery and electrical equipment. The No 1 125,000-KW generating unit and the main transformer have already been installed and the 400-ton boiler water pressure tests have been successfully conducted. A 150-meter-high smokestack and a 250-meter-long coal pier have been built.

The "Tai Dian" [for Taizhou Electric Power Plant] is a large-scale thermo-electric power plant the first stage of which calls for the installation of two generating units with a combined capacity of 250,000 kilowatts. After installation, these two generators can supply electricity to Taizhou, Ningbo, Jinhua and Wenzhou and other areas and will play a vital role in promoting the national economy and meeting the people's need for electric power. In order to achieve greater, faster, better, and more economical results, the "Tai Dian" builders have taken care to employ the latest technology and building materials in the construction. The 150-meter-high smokestack is an important auxiliary project with high requirements placed on quality. For this reason, the Zhejiang Second Construction Company charged with the project used the latest domestic methods to carry out the construction, not only assuring that the quality matched the advanced domestic levels for comparable structures, but also beating the original plan by 27 days. The plants's large circulating pump house is close by the Jiao Jiang and the base of the pit is more than 8 meters below the normal water level.

The outside water intake passes through a layer of rock more than 30 meters thick. Using normal underwater blasting methods would have been extremely difficult and highly dangerous but there was no time for alternate construction methods. To solve this problem, the personnel of a certain unit of the East China Sea Fleet Engineers employed advanced demolition techniques for the water intake and the pump house simultaneously, saving valuable time. The 400-ton boilers of "Tai Dian" are large with a large insulating area. When working on the boilers, the employees of the Provincial Thermo-electric Equipment Company used Chinese-made insulating materials which are lightweight, insulate well, have a high safety coefficient and are easy to work with.

The Taizhou Power Plant Under Construction

CSO: 4013/8

POWER NETWORK

WORK PROGRESSES ON FUJIAN'S BIGGEST THERMAL POWER PLANT

Fuzhou FUJIAN RIBAO in Chinese, 7 Jun 82 p 1

[Article by staff correspondent: "Third Phase Construction of Yongan Thermal Power Plant Begins, It Will Add an Installed Capacity of 200,000 Kilowatts and Be the Major New Source of Electricity in Our Province for the Next Five to Six Years"]

[Text] One of our province's key construction projects--the third phase of construction of the Yongan Thermal Power Plant is progressing smoothly after it began at the middle of last year.

According to reports from the construction site at the end of May, over three-fifths of the reinforced concrete frame for the No 5 boiler that is over 50 meters tall have been poured. Concrete structures for the steam turbine generator of the main plant have basically been done according to schedule. Recently, after completing the construction of 9 meters of the province's tallest and largest chimney of 180 meters, the advanced hydraulic slide casting technique was used to build the remaining portion. The construction period can thus be shortened and the quality of construction will be better. Originally, the construction of the chimney was scheduled for completion at the end of the year, but now it is hopeful that it can be completed by September. The installed capacity during the second phase of construction of the Yongan Thermal Power Plant was 150,000 kilowatts. The current phase of construction will add two 100,000-kilowatt generators. After completion, the total installed capacity will be 350,000 kilowatts, surpassing that of the Gutianxi Hydroelectric Power Plant to become the largest power plant of all the province's hydroelectric and thermal power plants. The annual output of the two added generators will be 1 billion kwh. This will be the major new source of electricity for the entire province in the next 5 to 6 years. According to requirements of the plan, the first generator will begin production by the end of 1984, and the second group of generators will begin production after 1985.

9296
CSO: 4013/120

THERMAL POWER PLANT TO BE BUILT AT SHIDONGKOU, BAOSHAN COUNTY

Shanghai WENHUI BAO in Chinese 15 May 82 p 1

[Text] The Ministry of Water Conservancy and Electric Power yesterday reached an agreement with the Shanghai Municipal Government to jointly finance the construction of a large-scale thermal power plant at Shidongkou, Baoshan County. The planned capacity of the plant is 2,400,000 kilowatts, which is three times the capacity of Shanghai's largest power plant, the Minfa power plant. The construction work will be done by the East China Power Development Bureau.

Shidongkou is located on an open field along the Chang Jiang. It is a convenient site in terms of building transmission lines and accessibility to water supply; also, there is no constraint on chimney height in that region, and the coal residues can be used to improve soil conditions in the area. Furthermore, because of its proximity to Baogang, this location provides suitable conditions for plant construction, transportation and living needs. Thus, it is one of the most desirable sites for a large power plant in the metropolitan Shanghai area.

Preliminary agreement between the Ministry of Water Conservancy and Electric Power and the Municipal Government calls for the installation of two 300,000 kw units during the first phase of the project. Upon completion of the power plant, the amount of electric power allocated for local consumption will be based on the proportion of actual investment received from the City of Shanghai; the remaining power will be distributed by the East China power network. Profits from the power plant will be used to pay back the principle and interest of local investment over several years.

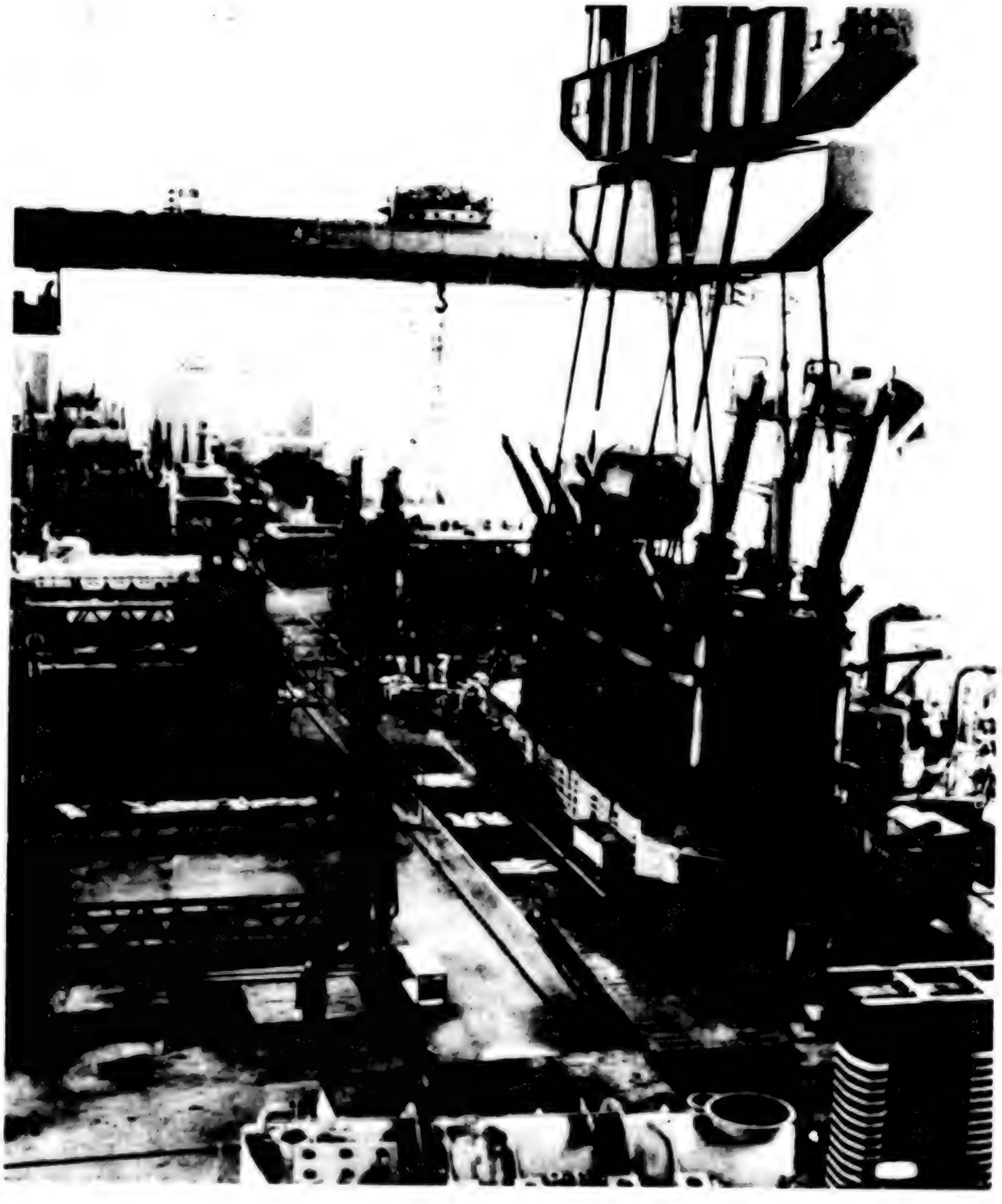
The new Shidongkou power plant will reduce the power shortage problem in Shanghai and in the Eastern China region; it is also designed to improve power distribution and provide economic benefits to the region. The first phase of the project will consist of all large, coal-fired units which can replace some of Shanghai's oil-fired units and the less efficient low-voltage units. It is expected that the power plant can save 600,000 tons of fuel oil and 700,000 tons of prime-grade coal each year, and at the same time improve the environmental conditions of Shanghai City.

3012
CSO: 4013/122

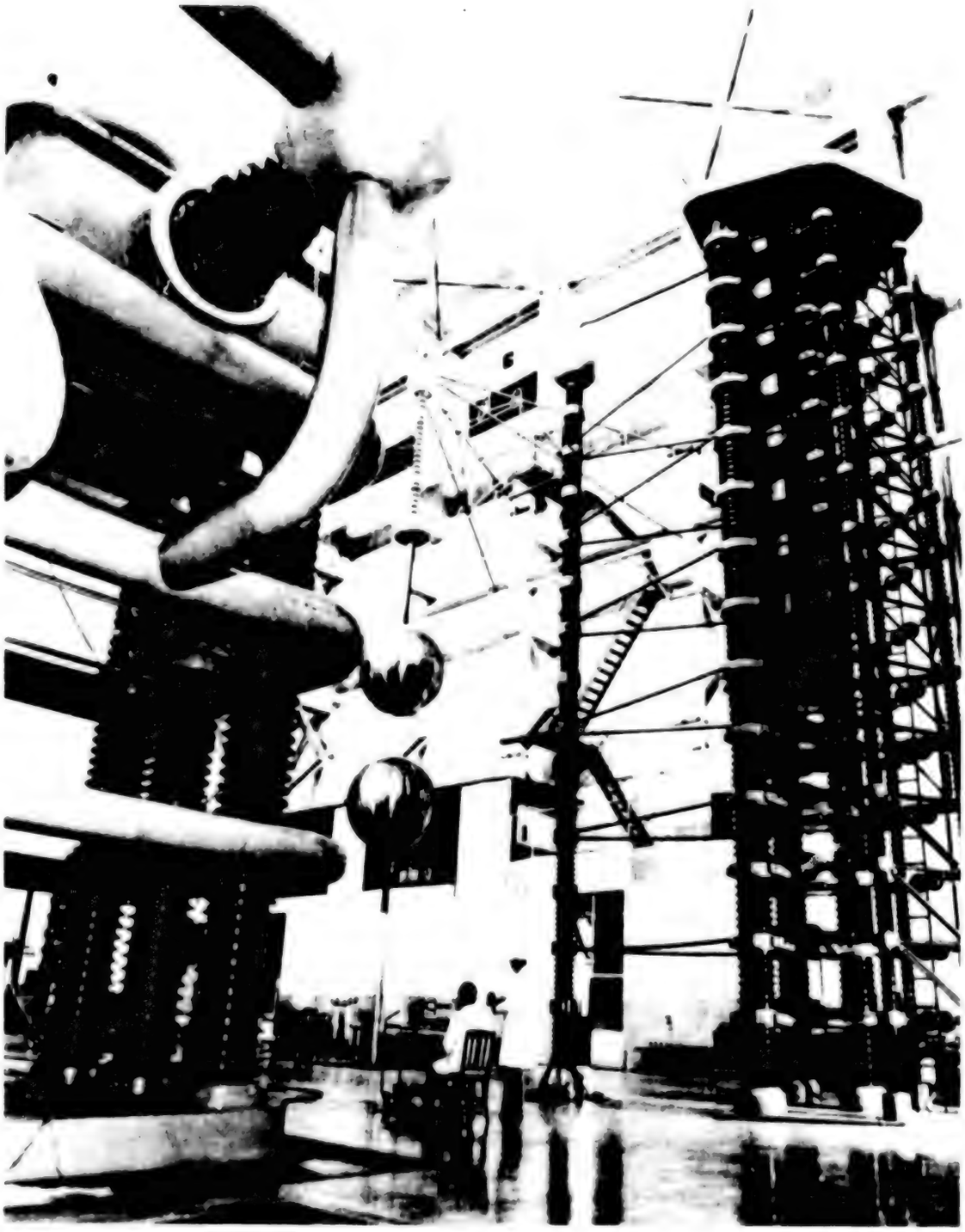
BAODING TRANSFORMER PLANT NOW PRODUCING 500KV ULTRAHIGH-TENSION EQUIPMENT

Shijiazhuang HEBEI HUABAO in Chinese No 4, 1982 pp 20-21

[Photographs and captions]



Giant Transformer Being Moved in the Assembly Shop



500KV Ultrahigh-tension Equipment Undergoes Simulation Experiment in the High Voltage Lab of the Plant's Transformer Research Facility.

CSO: 4013/171

SYMPOSIUM ON POWER SYSTEM PLANNING HELD IN NANNING

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 7, 5 Jul 82 p 76

[Article: "Academic Discussion Meeting on Power System Planning"]

[Text] The Academic Discussion Meeting on Power System Planning of the China Electrical Engineering Society was held in Nanning City, Guangxi from 22 to 27 March 1982. Seventy-seven delegates attended and 32 papers were received.

The meeting realized the following achievements through discussion and exchange:

1. The meeting proposed some computational methods and computer programs that can be preliminarily applied. Some have already been or are being combined with the actual power system for computational analysis.

2. Attention was paid to the importance of basic investigative research work and economic analysis, and the three projects on load forecasting, statistical analysis of the basic data on reliability and economic evaluation work are the basis for conducting systematic planning. The delegates felt deeply that we must quickly propose some basic data that suit our nation's situation and that can be applied in a definite realm to facilitate the development of planning work. For this, many rational suggestions were proposed.

3. The meeting clarified the direction of academic research work in planning. It can be seen from some papers that the application of new mathematical methods and concepts in power system planning has great technical and economic value. The attendees unanimously believed planning work must be combined with the situation in our nation, linking theory with practice must be insisted upon, and attention must be paid to the correct direction in economic benefits.

4. The meeting realized the policy of a hundred schools contend. Among the papers proposed at this meeting, many discussed the same problems using different methods. For example, in the optimization of no-work balance, there were papers on the three types of methods of linear planning, non-linear planning and dynamic planning. The proposal and exchange of these different viewpoints realized the policy of a hundred schools contend in academic exchange, and this has provided a good start for further development of academic discussion and research.

The meeting proposed many suggestions for future work. They are mainly the following:

1. Planning must obey objective economic laws. We must make rolling type plans to adapt to the continuous change in objective conditions.

2. The planning method and computational programs must be matched and they must be simple and easily executed. At present, there are already some computational programs which must be continually strengthened and perfected in application and practice.

3. We must emphasize basic work in planning and strengthen statistical analysis of data. The statistical compilation of data must, firstly, be aimed at the future, secondly, be favorable to production, thirdly, be simple and easy to carry out. The terms, definitions and methods in statistics must be quickly standardized.

4. We must cooperate with concerned administrative departments, refer to foreign experience and data and some of the actual preliminary experience already compiled domestically. We must first propose some parametric data for analysis, comparison and tests within a definite range so that related work in planning will have a common basis for gradual perfection later.

5. Reliability work must contribute toward improving the safe operation and production of electric power.

The conference made the preliminary arrangements for the academic activities this year and next year after discussion:

1. During the third and fourth quarters of 1982, a small-scale academic activity on reliability will be held with emphasis on statistical methods of data compilation. At the same time, the statistical information and achievements already available domestically should be exchanged to accumulate data, to analyze the types, and to facilitate gradual popularization.

2. It is planned that a special topic academic exchange conference on mutual links including specific topics on safety, superior quality and economic subjects in planning, design and operation should be held in autumn of 1983 to make technical preparations for the development of mutually linked systems.

The conference discussed and deliberated and with the approval by the standing committee of the China Electrical Engineering Society, officially established the special committee for power systems. The special committee decided to organize a special branch committee on relay protection.

9296
CSO: 4013/125

MALFUNCTIONS IN 110-KILOVOLT TRANSFORMERS ANALYZED

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 6, 5 Jun 82 pp 35-39, 29

[Article by Lin Min [0407 1940] of the Electric Power Research Institute: "Analysis of Malfunctions of Transformers of 110 Kilovolts and Over and Preventive Measures"]

[Text]

Foreword

In a power plant and a substation, the voltage and current transformers are electrical equipment directly connected to the bus. If they break down, often a blackout of the entire plant and entire substation will occur and this may even cause a system-wide breakdown. In recent years, incidents involving high voltage transformers have occurred frequently and they have caused great damage to the safe operation of the power system. For example, during the 5 days from 25 to 29 July 1980, the 100- and 220-kilovolt transformers of a certain power network exploded 4 times consecutively, causing a blackout over a large area of the power network. Also, for example, on 7 August 1981, a 220-kilovolt current transformer connected to the bus exploded at a certain power plant, causing the shutdown of two 300,000-kilowatt generators and five 220-kilovolt power lines and a loss of 6 million kwh of electricity. For this, the Production Department of the Electric Power Ministry held a panel discussion on the power system. The meeting was attended by some units. At the meeting, the transformers of the concerned regions were described. The meeting combined the experience at each locality and discussed measures to prevent such accidents and problems related to the quality of manufacturing. The accidents involving some of the transformers have been statistically tabulated and introduced below so that the safe operation of transformers can be improved.

II. Measures To Prevent Such Accidents

The key to improve operating reliability of transformers is to guarantee the manufacturing quality of the equipment. The Ministry of Electric Power proposed the "quality problems in 220-kilovolt and 110-kilovolt voltage and current transformers and opinions on improvement" in Document (81) Dianshengzi No 116 and attached documents dated September 1981. The document especially emphasized that we should strengthen product inspection. Measurements of

the angle of loss of medium, measurements of partial discharge, measurements of the water and air content in oil should be included in the final inspection before leaving the factory, and rejected products should not be allowed to leave the factory.

The large number of transformers that are in operation or that will begin operation are subjected to the following regulations stipulated in the "measures to prevent accidents involving 220-kilovolt and 110-kilovolt voltage and current transformers" promulgated as Document 117 by the Electric Power Ministry, the specifics of which follow:

(1) The top seal of newly installed voltage and current transformers must be carefully inspected before they begin operation. In particular, screw holes and other joints where water may penetrate should be kept well sealed to prevent water from penetrating into the equipment and from damage by dampness. We must insist on following the "criteria for the exchange of electrical equipment and preventive tests" and the supplementary testing rules when conducting tests.

(2) The production departments should measure the local discharge and the water content in oil before the equipment begins operation as much as possible.

(3) Effective rain-proof measures must be taken to protect voltage and current transformers that have already begun operation. Rain water must be prevented from penetrating through the ends of the transformers by adding a rain-proof cap or other measures to prevent penetration of water and damage by dampness.

(4) The seals on voltage and current transformers must be inspected once a year in combination with preventive tests to see if the respiration system is operating normally. The plastic coverings of transformers that have been operating for a longer time should be inspected to see whether they have aged or whether they have accumulated water. The possibility of water penetration and damage by dampness must be eliminated as much as possible.

5) There should be measures to repair or exchange as soon as possible the CC-220 voltage transformers manufactured before 1980 by the Taiyuan Transformer Plant and other transformers that have been tested and determined to contain serious defects. Before repairing such transformers, the period for preventive tests should be appropriately shortened and monitoring of operations should be strengthened. If a transformer is found to be smoking, the related power source should be quickly cut off. To facilitate testing, inspection and repair, the network bureaus and provincial bureaus can appropriately maintain some replacement equipment.

(6) We must strengthen preventive tests of transformers, especially measurements of medium damage and capacitance stipulated in the "criteria for exchange of electrical equipment and preventive tests" and the supplementary rules, chromatographic analysis of oil, measurement of the water content in oil and measurement of local discharge. These tests are more effective in discovering water penetration, damage by dampness and local defects. We should also pay attention to the changes in test results. Comparative and

comprehensive analysis should be conducted before and after the tests. We should not be satisfied with simply complying with the regulations and rules. Some of the medium damage values stipulated in the regulations are slightly greater. Each locality can determine the value based on the results of several increment analyses.

(7) Installed transformers that do not operate for a long period are easily affected by water penetration or dampness. Therefore, before they are charged, they should also be tested and inspected. When necessary, they can first be connected to the bypass bus for testing over a period of time before they join operation.

(8) If the transformer's main insulator emerges from the oil surface after core inspection or other reasons, vacuum pumping of oil must be done during reinstallation. The residual pressure in the vacuum should not be greater than 10 millimeters column of mercury. The air in the injected oil should be removed.

(9) The X end of the high voltage coil of the voltage transformer and the end shield of the one-time capacitor core of the current transformer should be inspected after installation or after major or minor repairs if they are to be grounded for operation according to regulation.

(10) In the method of operation of the system and in reverse switching operations, we should pay attention to preventing ferromagnetic resonance and operating with an overload voltage to avoid damaging the transformer.

(11) To reduce the area affected by transformer accidents, bus differential protection should be put into operation, and we must pay attention to the method of connection of the second coil to avoid the occurrence of an unprotected dead zone at the bottom of the U-capacitor core of the current transformer.

III. Several Experiences

Because of the ceaseless occurrence of transformer accidents in recent years, each locality has already accumulated some experience in the inspection transformers at the time of delivery, in measures to prevent dampness, in new testing techniques and in methods of determination. These will be summarized and introduced below.

1. Preventing Dampness and Water Penetration

According to reports by the Shanghai Power Supply Bureau, the seal on the oil tank of the transformer must be inspected at the time the transformer is inspected and received for use. The method is to conduct a pressure test of the cap and the plastic cover by applying a pressure of 0.5 to 1 kilogram/square centimeters. Those not passing the test must be exchanged. For example, in one test of 9 current transformers, it was discovered that all plastic covers and 4 end caps leaked. They exchanged the defective caps with self-designed caps on the $LCLWD_3$ and the $LCLWD_3$ model current transformers. They added a plastic oil seal on the T ? H-220 current transformers. Huadong

Architecture proposed two ways to improve the seals on the transformers in operation. One was to add a plastic seal on the small oil cushion at the ground potential, i.e., a small common cushion that was higher than the ends, that contained a tightly sealed plastic cover and that was connected to the bottom oil release valve was added to each group of transformers. This method is already been used at the Xin'an Jiang, Baishi Jiang and Danjiang power plants. The second way was to fill the plastic cover at the equal potential with nitrogen for protection so that the nitrogen inside the plastic bag covered the top of the oil surface. In 1966 the Wangting Power Plant began to add such plastic covers on three of its 220-kilovolt transformers. Water did not penetrate any of them during the past 15 years and the oil quality and insulation were good.

2. We should conduct local discharge measurement

At present, many units have already implemented measurements of local discharge. For example, the Shandong Electric Power Research and Experimental Institute required that before a transformer begins operation, it must be subjected to ordinary tests as well as local discharge tests under a voltage of 1.3 times the specified phase. Transformers that show abnormalities are not placed in operation. The Shanghai Power Supply Bureau considered the pros and cons of core inspection at the time of receiving the transformers and decided not to lift the core of newly received transformers but their local discharge must be measured. The electrical method was used to take measurements under 1.3 times the specified phase voltage and the standard was not to use more than 20 micro-micro coulombs for control. With the assistance of the Huadong Electric Power Experimental Research Institute, they tested more than 50 units and they have created conditions to prepare transformers in operation for testing one by one.

3. Measurings tgδ

Voltage transformers can be measured comparatively using different methods of connections. The Dongbei Technical Improvement Bureau reported that an effective method to test poor insulation of the supports is to measure the tgδ of the voltage transformers using the "end shielding method". Because the seat of the transformer must be insulated from the ground when testing the tgδ of the insulating supports using the QS_1 bridge measurements, therefore, it is more convenient to test it at the time of delivery and inspection. The Fuzhou Power Supply Bureau used the method of positive and reverse connections and end shielding to test the tgδ of the voltage transformers. In testing 20 units, 3 transformers with different defects were found (using the QS_1 bridge). The results of the tests are shown in Table 6.

Because the effect of dampness of the current transformer generally begin the surface layer, therefore besides measuring the medium damage of the main insulation and the capacitance value, it is more effective to measure the ground insulating resistance of the end shield, medium damage and capacitance and to compare and analyze the measured values. The standard allowable value for the tgδ of the capacitance type current transformer is 3 percent. Many units believe this is too broad and it is difficult to detect defects. The

Liaohei Technical Improvement Bureau showed that accidents have occurred when the tgδ value was far smaller than 3 percent in several actual breakdown incidents. Therefore, the Administrative Bureau of the Northeast Power System stipulated that the tgδ should not be larger than 1 percent at the time of delivery and it must not be larger than 1.5 percent during operation. The regulations also stipulated that the numerical value of the phase intervals measured must be compared to past results and the incremental multiple of that phase can be calculated according to the following formula: Take phase A as an example:

$$K_A = \frac{A_2/A_1}{(B_2 + C_2)/(B_1 + C_1)} - 1$$

where A_1, B_1, C_1 are the tgδ values measured the last time on the equipment of each phase of the same group.

A_2, B_2, C_2 are the values measured this time on the equipment of each phase of the same group.

When the value of K is greater than 0.5, the items to be tested must be increased and monitoring must be strengthened.

When the value of K is larger than 1, further efforts must be made to find out the cause. If the tgδ value measured is smaller, and when the multiples increase due to errors in the measuring instruments, then the doubt can be resolved.

4. We should measure the water content in oil

This method is one of the effective methods of measurement that is more directly related to measurements during operation. Although there are no unified standards at present, but because the operating temperature of the transformers is lower, there is less oil, penetration of water into the interior will visibly change the water content in the oil. If the measured results before and after contamination are contrasted, then it would be easier to make a judgment. The Northwest Electric Power Experimental Research Institute, the Electric Power Science Research Academy and such units tested several transformers containing more than the normal amount of water (all greater than 30 ppm). Their medium damage was also above 2.5 percent. And it was proven that the interior contained water. This testing method still requires more experience to gradually grasp the pattern of the water content in oil during operation.

5. Chromatographic analysis of gases in oil

The use of chromatographic analysis to detect breakdowns of oil filled electrical equipment has already been applied in power systems. In particular, the possibility of breakdowns due to local discharge of current transformers is greater. But it is not convenient to test the local discharge by pressurization at the site, but chromatographic analysis can show its superiority. To facilitate contrasts, the base value should be measured at the time the transformer begins operation for later comparison and its pattern of change

should be observed. In judging breakdowns due to discharge, the key is the content of ethylene. In discussing the establishment of guiding principles for chromatography, two different views concerning the standard content of ethylene have been proposed. Finally 5 ppm (approximately 0.005 percent of the concentration of the gases) was taken as the standard. The plants and bureaus directly under the jurisdiction of the Northeast Power Administrative Bureau have temporarily established the chromatographic breakdown value at 0.001 percent of acetylene and the percentage of total hydrocarbons at 0.05 percent. Therefore, each locality can establish related regulations that combine the situation of the locality with the approval by the local supervisory departments based on each locality's own experience.

IV. Conclusion

At present, the urgent task is to improve the manufacturing quality of transformers. Concerned manufacturing departments have already begun such improvements and they should guarantee the quality of the products and practical results. Monitoring and maintenance of the many transformers that are already operating or will be placed in operation soon should be strengthened by implementing the (81) Dianshengzi No 117 document of the Ministry of Electric Power to improve the level of technical management of operations. Measures to prevent explosions related to the problem of chain reactions caused by the explosion of the porcelain casing when transformers break down should be considered when designing the interior of the structure or the power distributors as early as possible so that damage due to such accidents can be confined to the minimum.

9296
CSO: 4013/97

POWER NETWORK

ANALYSIS OF LOSS OF STABILITY IN SOME GRIDS

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 6, 5 Jun 82 pp 6-11

[Article by the Technology Office of the Production Department of the Ministry of Water Conservancy and Electric Power: "Analysis of Some Incidents of Loss of Stability in Power Networks"]

[Excerpts] De loping power networks is the objective law of the electric power industry. As the power network develops and enlarges, its superiority becomes more and more visible. Large power networks can more rationally utilize power resources than small power networks and can operate more safely and economically. But, we cannot neglect some characteristics and problems of large power networks. Large networks have large power plants and long distance transmission lines which are all closely connected. Breakdowns that occur in any equipment or power line will create a chain reaction. If certain links breakdown, they may interrupt stability and cause a blackout over large areas and even cause the entire network to collapse and bring about serious loss to the national economy. Therefore, while developing the superiority of large power networks, we must fully pay attention to the problems brought about by large networks, and we must especially pay attention to and solve the problem of network stability before we can guarantee the safe and reliable operation of the power network.

Over the years, our nation's power networks have developed quickly. The structure and technical equipment of the power networks have been continuously improved. But incidents of losing stability in some power networks have occurred during the course of development because the structure was weak and because there were problems in operation management. Conscientiously summarizing the lessons of these incidents enables us to gain a clearer understanding of the characteristics of the power networks and their patterns and to gain more experience in the management of the networks and their operation. This is very important in further improving the safe operation of the networks.

II. Lessons Learned From the Experience of Accidents

(I) The Problems of Power Networks Must Be Fully Understood and Emphasized

The development of some power networks lacks planning. Power transmission and transformation facilities cannot catch up with power generation. Facilities

for phase modulation, voltage modulation, protection of relays, communication, telekinetics cannot catch up with power transmission and transformation. These have weakened the structure of the power networks. As a power network expands, a series of problems will necessarily be created. The problems that are more visibly exposed are incidents of loss of stability in the power networks.

Operation is not economical in places where more accidents caused by structural problems in the networks have occurred. This is because the transmission capacity is limited. Hydroelectricity cannot be fully utilized and the load of thermo-electric power cannot be distributed according to economic conditions. In addition, because the transformers and the power lines are frequently overloaded, or because they operate near the limit of staiblity, or because the lead line transmits power at the limit of stability, the loss of the network is also greatly increased.

(II) While Drawing Up Stability Measures for Power Networks, We Must Consider the Worst Situation That May Possibly Occur.

A fundamental experience, summarized after many years of accidents, shows that in order to guarantee the safety and reliability of a power network, we must start out from the worst situation in our overall study and analysis. When the technical and economic conditions are rational, we should take corresponding measures to prevent the power network from collapsing and to minimize the effect of an accident so that we will be prepared for any eventuality. The structure of the power networks in Europe and the United States is generally tighter and the facilities are better. But in the past, many serious incidents of stability loss still occurred and even caused the whole network to collapse. Analysis of the causes shows one common point. It is believed that the structure of the network is already very strong and that the emergence of the worst condition would cause a loss of stability was not taken into consideration, and what kind of remedial measures to take when a loss of stability occurs was not considered. As a result, when vibrations occurred, relay protectors operated chaotically causing the power network to become disconnected and this developed into a nation-wide collapse. Later, "standards for reliability" of power networks were drawn up on the basis of the experience of such incidents.

The so-called "worst condition" mainly refers to the problems that have actually occurred or may actually occur. For example, in the past, consideration was generally not given to the problems of triple phase circuits. According to statistics of breakdowns of some 220-kilovolt lines of some power networks, shorting of the triple phase circuits constituted 4 percent of the total number of breakdowns. These power networks followed the revised guidelines. Stability calculations and analysis aimed at the shorting of triple phase circuits have proved that it is possible to follow ordinary measures currently in force to guarantee stability in most regions without lowering the original transmission capacity. Also, problems involving breaks in operating power lines due to unknown reasons, loss of magnetism of any one of the generators, simultaneous breakdown of power lines on the same pole, on-off switching vibrations, protective vibrations or multiple breakdowns, etc. have all

occurred. They must be considered separately with the structure of the power network and the nature of the breakdowns: for example, under which conditions should stability be maintained and should the normal load of electricity be supplied; under which conditions should stability be maintained while a loss of a part of the load is allowed; which conditions might cause a loss of stability and what definite measures should there be to quickly restore the normal operation of the system and to reduce the loss as much as pos le, etc.

The implementation of the "guiding principles for the safety and stability of power systems" will surely strengthen the analysis of the safety and stability of a power network in planning, designing, production and operation. On this basis and with the prerequisite of rational technical and economic conditions, the structure of a power network can be strengthened and corresponding technical measures can be taken.

(III) We Must Solve the Imbalance in the Building of Power Networks in a Key Way, Work Toward Perfection, Strengthen the Structure of the Power Network.

In structuring a power network, we should consider the following: The structure of a power network should be strengthened according to the principle of "quickly forming the main high voltage trunk line level by level and region by region and clearly separating the main lines and the auxiliary lines."

1. We should strengthen the weak links and establish main high voltage trunk lines

A power network should quickly build its main high voltage trunk lines to connect the major power plants (including the main power plant at the center of the load) of the power network directly together to form a strong network frame for the power network. This will enable the network to have a wide adaptability, a good ability to respond to changes and an ability to resist interference.

A power network has main trunk lines and branch lines. The establishment of the main trunk lines should consider the following requirements:

(1) The main trunk line should consist of double return circuits of the same voltage level or closely connected ring networks.

Weakly linked large ring networks and high and low voltage electromagnetic ring networks cannot serve as the main high voltage trunk lines because when these ring networks malfunction they cannot provide mutual support. Double return circuits on the same pole were cut off because the pole fell down causing an important power network to be on the edge of losing stability. Therefore, we must be careful when using this type of power lines. If the power line corridor is difficult to solve, we should strive as much as possible toward utilizing it in a relatively short time. At this time, the structure

of the power network should take into consideration the problem of how to guarantee the safety and stability of the power network when both circuits jump the switch simultaneously.

(2) The main trunk line should avoid T-connected power sources.

(3) The main trunk line should avoid serial rings of ultra-short circuit lines among short circuit lines.

(4) The main trunk line should avoid being connected to the same substation.

Connecting a main power plant with the power network using a single return circuit is unsafe and uneconomical. We should quickly create conditions to build main high voltage trunk lines so that the structure of the power network can be strengthened.

2. Dividing the power network into levels and reforming the structure

Some power networks have a low level of stability. The power transmitted by large power plants is limited and affected by the stability of the power network. This is closely related to the fact that the power plant easily becomes unsuited to the voltage level of the output line and the rings. When building power plants in the past, we often gave too much consideration to the regional power load, but from the operation of several large power plants we can see that the estimates of local consumption of electricity were all too large and the prerequisite conditions had to be changed. In addition, the development of the power network, changes in the power source, considerations for inspection and repairs or accidents will bring about even greater change in the operating method of the power network, and the tidal current of the load will undergo greater change. The structure of the power network determined by the principle of local balance cannot adapt to the above changes.

Therefore, the structure of the power network must be considered from the point of view of the whole network and from the long range view so that the network will have the ability to adapt to changes. This requires considering the problem of separating the network into levels.

The so-called separation into levels refers basically to separating the power system into levels according to voltage (including the power plant, substations). According to the experience of accidents and operating experience, and contrasting the experience with the actual situation of the power network, a power plant with a capacity of 300,000 to 400,000 kilowatts connected to a 110-kilovolt power network is slightly low. A power station with a capacity of about 1 million kilowatts connected to a 220-kilovolt power network is also slightly low.

The principle of separation into levels involves many factors. It needs to be combined with the actual situation for further research. We believe that as long as the voltage level of a power network is appropriately selected, as long as a higher level voltage emerges early according to the needs of the power network, as long as the power plant is correctly connected to the power network according to the voltage level, then the problems of the lead

line or problems of thermal stability of the equipment, problems of the capacity to cutoff the switch or problems of stability of the power network generally are more easily solved.

3. Regional division of the power network guarantees safety

Analysis of the structural characteristics of a power network shows that besides separating it into levels, it also has regional divisions. According to the conditions of our nation's power networks, there are many weak connections between regions. In the past, a main reason that accidents related to stability had created relatively large loss was insufficient emphasis on the problems brought about by the characteristics of regional division, especially the weak links.

(1) We should establish disconnecting points according to the characteristics of regional division

There are strong and weak connections within a power network or between power networks. When there is a slight disturbance in a power network, reflections are most sensitive in the weak connections. We need to establish disconnecting points. After disconnection, each region can balance the power source and the load as much as possible or achieve a balance by such measures as reducing frequency and reducing the load. Only in this way can the superiorities be developed and the weak points be overcome.

It is frequently difficult to establish disconnecting points in an operating system because of the structure of the power network or the connecting lines of substations. Therefore, this problem must be considered during the planning and designing stage of power networks.

Regional power plants that have an especially weak connection with the system will lose stability the earliest when a disturbance occurs in the system. We should consider establishing disconnecting points.

Double buses, as a method of connecting lines, facilitate the distribution of power sources and loads on each bus, and they make it easy to establish disconnecting points.

(2) We should enlarge the power network and pay attention to regional characteristics

When developing large regional power networks, most of them may be weakly connected networks and they are gradually changed from weak to strong links according to the needs of the loads and economic conditions. According to regional characteristics, besides considering disconnecting points, the structure of a regional power network within each region should be strengthened. All accidents of the regional power networks should be solved within the region. They should not affect the safety and stability of the neighboring region.

The stability of connected lines between neighboring regions is the responsibility of both regions. The connecting line should not be affected because the

accident has enlarged. When the connecting line malfunctions and jumps the switch, each region should maintain stability on its own. Joint networks with weak connections must also consider corresponding measures to prevent low frequency vibrations.

4. Necessary facilities to match the power network

To guarantee that a power network operates safely and economically as a complete power network, besides the facilities such as power plants, substations and power lines, there must also be indispensable facilities for phase modulation, voltage modulation, relay protection, dispatching, communications, telekinetics and automation.

(IV) We Must Strengthen Analysis of Mock Accidents and Stability Computations

1. Analysis of mock accidents

Accidents can occur anywhere in a power network. We should conduct stability analysis of mock accidents based on the most unfavorable conditions that are actually possible. During the course of computational analysis, we should take preventive measures. The content of analysis of the imaginary situation should be based on the requirements of the "guiding principles for complete stability of power systems" and be determined by a combination of past experience of accidents of power networks and the concrete situation.

2. Post-accident analysis

After every incident of losing stability, we should examine and analyze the course of occurrence of vibrations, their development and restoration to grasp the operating principles and analyze the function of various measures. At the same time, we can also examine the accuracy of the method of computation and the means of computation by contrasting the calculations with the data related to the vibrations in the recorded wave photographs of the breakdown. The breakdown of key parts of a power network, especially serious breakdowns although they did not create a loss of stability should also be examined, contrasted and analyzed.

3. Analysis of the various methods of operation

Basic stability analysis must be carried out for normal operating methods or operating methods during inspection and repairs. Stability calculations corresponding to the various methods of operation of the whole network (especially the weak links in the power network) during the seasons of flooding or drought must be done beforehand and procedures for stable operation should be compiled to guide dispatching operations.

4. Analysis of the structure of power networks

When a powernetwork is operating, problems related to the structure of the power network should be analyzed and pointed out while carrying out the above analysis so that these problems can be gradually solved in combination with efforts of building the power networks or with construction projects to perfect the network.

In addition, to prevent the occurrence of many incidents involving stability caused by a collapse of voltage, we must also emphasize the quality of voltage of the power network and the problem of providing no-work compensation facilities. We must maintain the capability of forced excitation of the generator and normal operation of the devices that automatically adjust excitation and we must gradually improve their performance when manufacturing them.

(V) We Should Fully Develop the Function of Automatic Relay Protection and Safety Facilities

Generally speaking, the fundamental prerequisite of maintaining the stability of a power network is to strengthen the structure of the power network. But if we can fully develop the function of relay protection, we can make up for certain deficiencies in the structure of the power network to a definite degree.

1. We should hasten the cut-off time of breakdowns

According to actual computational analysis of a certain system, when a large hydroelectric power plant generates a lot of hydroelectricity, if a triple phase short circuit occurs at the power line exit, the cut-off time is 0.2 seconds. No measure can stabilize this. If the time can be reduced from 0.2 to 0.15 seconds, it would be greater than the time required for initiating an electrical brake of 140,000 kilowatts temporarily by the hydroelectric power plant. This combined with some ordinary measures can guarantee stability. When the time is lessened from 0.15 to 0.1 seconds, it would be longer than cutting off two 75,000-kilowatt generators by the hydroelectric power plant. Results of computational analysis of another power network similarly proves that as long as the breakdown is cut off in 0.1 second, the condition that guarantees the stability of the triple phase short circuit (not overlapping) approaches the condition that guarantees permanent single phase grounding. On this basis, we can take additional ordinary measures (such as electrical braking, cutting off the generator or temporarily reducing output) to increase the level of stability from guaranteeing single phase grounding to guaranteeing the stability of the triple phase short circuit while maintaining the original transmission capacity of the power network.

The switches for voltages of 220 kilovolts and above produced by manufacturers at present and the newly produced protective equipment can satisfy the requirement of cutting off the triple phase short circuit breakdowns on 0.1 second.

2. We should improve the method of overlapping switches and the time of adjustment and improve the success rate of combined power line switches

According to analysis of accidents, using single phase overlapping switches on power lines with many parallel and relatively short circuits will not be beneficial, and because it is difficult to match protective devices, cross level jumping of switches occurs or the cut-off time will be too long, causing a loss of stability. Therefore, triple phase overlapping switches should be used as much as possible on the above power lines whenever the use

of simple triple phase overlapping switches can satisfy stability requirements. In particular, single phase overlapping switches have to be used for communications lines of single return circuits of the power network, including especially large ring networks and power lines with high and low voltage ring networks.

When setting the time of overlapping, we must consider not only arc extinction conditions, another important condition is to select a time for overlapping that is most beneficial to the stability of the power network. The overlaping switch should be thoroughly improved as required by measures to prevent accidents so that the success rate of overlapping can be improved.

3. Improve protection of the bus and rate of input of high frequency protection

When an unprotected bus breaks down, it will usually cause a loss of stability. Therefore, the function of protecting the bus not only involves the safety of one power plant and one substation, it also serves an important function in maintaining the safety and stability of the entire power network. Some accidents indicate that the input rate of high frequency protection for the power network is low and thus when other types of protection (such as zero-order current protection or distance protection) refuse to function, a serious consequence is created. In addition, in some power networks, because high frequency protection did not function, rapid cut-off of the whole power line could not be done. This reduces the dynamic and stable levels and even causes eddy currents. Providing sectional protection is difficult in power networks with a relatively tight structure and with shorter power lines. For example, even high frequency protection can hardly guarantee the stability of the power network under serious malfunctions.

4. Implement measures to prevent accidents in distance protection and zero-order current protection

Practice proves that many power networks have implemented the measures described above to prevent accidents and have basically solved the problems when these protective measures refused to function and when they functioned by mistake. Therefore, these measures should be continued and completed. We should especially point out that the various distance protection measures which have been used on relatively long power lines but have not been improved and which still retain a negative order voltage startup will still refuse to function when a triple phase short circuit caused by striking thunderbolts occurs. If this happens, serious loss of stability in the network will be caused and this problem must be emphasized and solved.

5. Fully develop the function of automatic safety devices

Power networks whose stability has not been sufficiently analyzed frequently are not equipped with corresponding automatic safety devices, or the devices equipped do not meet the actual needs and the results are not visible. In addition, some devices need to be further researched and developed for production.

CSO: 4013/97

POWER NETWORK

SERIOUS DROUGHT FORCES YUNNAN TO INSTITUTE ELECTRIC POWER ECONOMY

HK250638 Kunming Yunnan Provincial Service in Mandarin 1100 GMT 24 Jul 82

[Excerpts] In light of the serious drought this year, which has caused a grave water shortage for the eastern Yunnan power grid, the provincial electric power bureau has, with the approval of the provincial people's government, adopted emergency measures and instituted planning, responsibility and priority in power consumption. Beginning midnight last night, the bureau is keeping the daily power generation of the eastern Yunnan power grid below 10.2 million kwh, a cut of about 1 million kwh a day.

Since 1980, as the province's industrial and agricultural production has registered sustained increases, the contradiction between power supply and demand has become more and more prominent. In particular, power consumption on the eastern Yunnan grid has risen by an annual average of about 5.2 percent. Consumption in the first half of this year was 5.7 percent greater than in the same period of last year.

The provincial electric power bureau has greatly increased hydroelectric power generation in order to meet consumers' needs. Installed hydroelectric power capacity on the eastern Yunnan grid alone accounts for 69.2 percent of the grid's total capacity. However, since 1980 and 1981 the level of the (Baojiashan) reservoir on the Yili River has fallen continually, while the Erhai Lake has rarely been as dry as it is now. Thus the water level usable for power generation in the two big reservoirs has continually declined. According to an analysis of present precipitation conditions, this year will also be dryer than normal. Hence, unless emergency measures are taken to control power generation on the eastern Yunnan grid below 10.2 million kwh, by next year the 2 big reservoirs on the Yili and Xier rivers will have no water for power generation. This will cause serious losses to industrial and agricultural production in the whole province. In view of this, the provincial electric power bureau is taking the following steps in accordance with the provincial government's instructions:

1. Do a good job in planned, economical and priority consumption of power. All areas and departments must bear the overall situation in mind; they must refrain from stressing their own production tasks and, on that account, fail to implement economy measures. Power management personnel must step up inspection of power consumption by consumers.

2. Do a good job in production safety and avoid accidents.

3. Promote capital construction to increase power generation. Speed up the construction of the power line from (Pingdiansi) Power Station to Yuzi and work hard to get No 3 generator (Pingdiansi) into operation as quickly as possible, so that southern Yunnan's power can rapidly take up the load of Yuxi Prefecture and thus ease pressure on the eastern Yunnan grid.

CSO: 4013/159

DIFFERENT TYPES OF HIGH-TENSION CIRCUIT BREAKERS DESCRIBED

Shanghai DIANSHIJIE [ELECTRICAL WORLD] in Chinese No 2, 1982 pp 40-41

[Article by Cao Rongjiang [2580 2837 3068], Gu Nihong [7357 7206 7703] and Hua Wenxiang [5478 2429 4382]: "High-tension Circuit Breakers"]

[Text] Everyone knows that the electricity generated by a generator is transmitted by high-tension or ultrahigh-tension power lines. In slow and lengthy power transmission and distribution systems, high-tension circuit breakers are used at many places to connect or to break the high-tension circuit and to rapidly isolate any accident when it occurs in the system. They serve the dual function of control and protection. Because they serve a switching function, some people also call them high-tension switches.

The size of high-tension circuit breakers (the voltage is over 3 kilovolts) increases drastically as the voltage and the cut-off current increase. For example, a three-phase high-tension circuit breaker of 330 kilovolts and 2,000 amperes occupies 220 square meters, its single phase height is 6 meters, its length is 7 meters, and it weighs 13 tons.

General Description of the High-tension Circuit Breaker

The high-tension circuit breaker will produce an electric arc when the current is cut off. People have thought of using water to extinguish it. Some circuit breakers with a relatively low voltage use "water" to extinguish the electric arc, and they are called water circuit breakers. The "water" is distilled water with a little ethylene glycol added to lower the temperature of solidification. Some dyes are also added.

Water is not a good insulator. Its ability to extinguish the arc is very low. Therefore people have used oil in the transformer to extinguish the arc. Oil produces a large amount of hydrogen when it is charged by the electric arc. Because hydrogen has a strong ability to remove heat, therefore the ability of oil to extinguish the arc is strong. This type of circuit breakers is called oil circuit breakers. Some have more oil and some have less. The bulk oil circuit breakers, such as the DW8-35, the DW3-110 (Figure 1), and the DW3-220 use oil as the ground insulator and they are mainly used in substations of 35 kilovolts and less. As the capacity increases, the outer shell becomes larger and larger and the

amount of oil used increases (for example, the weight of the oil in a three-phase 220-kilovolt circuit breaker is 48 tons). This is very uneconomical, and there is the danger of fire. Therefore, people have designed circuit breakers with low oil content. The oil is used only to extinguish the arc and ground insulation is realized by porcelain parts. Those used in indoor substations include the SN10-10 and SN10-35, and those used in outdoor substations include the SW2-35 (Figure 2), SW3-110, SW4-110, SW7-110, SW6-220 and SW7-220. They use only several dozen to several hundred kilograms of oil, while the amount of oil in the bulk oil circuit breakers that use a lot of oil is several dozen and several hundred times more. Because the principle of the device to extinguish the arc in oil circuit breakers mainly relies on its own energy, the cut-off current cannot be too large, and when cutting off a small current (critical current), the time required to ignite the arc is longer.

Blowing out an oil lamp can extinguish fire, therefore people have also thought of using air to blow out the electric arc. This is called an air circuit breaker (Figure 3). To speed up the blowing force, generally air is compressed to 20 to 25 atmospheric pressures. When in action, the compressed air passes through special holes to blow out the electric arc. The action of such a circuit breaker is fast. The time to ignite the arc is short. The medium can be conveniently renewed. The circuit breaker can operate many times and it does not present any danger of causing a fire. Therefore it is suitable for use in high-speed automatic overlapping switches. It can be made into a circuit breaker with the highest voltage and the largest capacity. It is mainly used in large capacity power stations of 110 kilovolts and higher, substations and in the protection of generators.

In recent years, people have also found a medium called sulphur hexafluoride (SF_6). Under normal temperature it is a gas. Pure SF_6 is tasteless and non-toxic. Its ability to extinguish the arc and of insulation is much stronger than air and transformer oil. Therefore, people have manufactured the sulphur hexafluoride circuit breaker. It has the following characteristics: Because of its good insulation, its size can be made smaller. SF_6 gas can be recycled internally in the container. As long as it is well sealed, the circuit breaker can be used for several dozen years without repairs and there is little noise during operation. Structurally it can be divided into the single pressure type and the dual pressure type. The first can also be divided into fixed gap and variable gap types. The lead wire, the knife switch, the current transformer, the voltage transformer, and even the lightning rod can be contained in one whole unit, forming a composite box type sulphur hexafluoride circuit breaker (Figure 4). It saves land and space so it is suitable for use in building underground substations and substations in crowded urban areas. It is mainly used in large capacity substations of 110 kilovolts and above and stations where frequent operation is required.

The electric arc is a concentration of electrons. As long as the density of electrons drops, the electric arc will not continue to exist. Because the interior of concentrated groups of electrons has a relatively large pressure, therefore when they are released in a vacuum, the material of the arc column will rapidly disperse into the surroundings, and the elect arc will be quickly extinguished. Therefore, people have made the vacuum circuit breaker (Figure 5). A hard glass bubble or porcelain container made of clay with a high content of aluminum oxide is pumped to create a vacuum of 10^{-4} millimeters mercury column or smaller. At present, our nation has attempted to manufacture 35-kilovolt class vacuum circuit breakers. Foreign nations have produced single break 84-kilovolt and multiple break 168-kilovolt circuit breakers. The advantage of this circuit breaker is that it can operate up to several tens of thousands times. It is fire-proof and explosion-proof. It is light and small. Its cut-off tolerance load is better than other circuit breakers. It does not need inspection and repairs and when it breaks down the vacuum bubble can be replaced. It is mainly used in indoor substations of 35 kilovolts or less and in industrial and mining enterprises where frequent operation is required. It has almost replaced all other types of circuit breakers of the 10-kilovolt class used in Japan and such nations.

In addition, there is the domestically produced air-blast circuit breaker (Figure 6) used for lower voltages. It relies on the high temperature produced by the cut-off electric arc to gasify certain materials and thus form a strong blast to extinguish the electric arc. Its structure is simple. Its manufacturing cost is low, its use and maintenance are convenient, its cut-off ability is not great, and it is mainly suitable for use in outdoor small capacity power networks of 35 kilovolts and less in farm villages or simple substations.

There is another type of circuit breaker that relies on the deionization grid to extinguish the arc. It is called the magnetic blowout circuit breaker (Figure 7) [not shown]. It uses the magnetic force produced by the cut-off current itself to drive the electric arc into a series of deionization grids that are tolerant to burning by the arc to bend and lengthen the arc so that the electric arc column and the surface of the deionization grids come into frequent contact and heat is dissipated continuously to achieve the purpose of extinguishing the arc. Its use and maintenance are simple, the useful life is longer, and there is not danger of fire or explosion. It can adapt to frequent operation. It does not produce surplus voltage during operation, but its capacity is not large and it is more expensive.

Besides the various types of circuit breakers described above that have already been produced in batches, there are other plans being considered, such as the synchronous cut-off circuit breaker and the circuit breaker that utilizes silicon controlled components.

Testing Circuit Breakers

A circuit breaker serves to protect and operate a power system, therefore a minute malfunction, even a small leak in the sealed coil or jamming of a small part that leads to a breakdown in operation will cause an accident and even cause large area power blackouts as large as an entire province or prefecture. The economic loss caused by one such accident will be 100, 1,000, or even 10,000 times the cost of the breaker itself (from 1,000 yuan to several hundred thousand yuan) or more. For example, once a circuit breaker exploded and it caused an economic loss of more than 10 million yuan. Therefore, we should first pay attention to the quality and the advanced nature of the technical characteristics of high tension circuit breakers, and then its price. We should not consider it in reverse. Then when we select the type of circuit breakers for a particular need, we should consider safety and reliability as priorities, otherwise we will not be able to guarantee a normal supply of electricity. In the manufacturing of circuit breakers, we cannot just pay attention to the amount of iron loss, the amount of copper loss, lightness, smallness, implicity and cheapness, we should pay more attention to safety and eliability.

ecause of the importance of high-tension circuit breakers, we must guarantee their performance. But up to now, modern technology has not yet been able to express and forecast all of the internal processes completely using formulas of mathematical analysis in the study of the electric arc. This means the ability of the circuit breaker to cut off the electric arc still cannot be solved by computation, but only by experiments. This requires the establishment of testing equipment so that the circuit breaker can generate high voltage and provide a large electric current. For example, testing one circuit breaker of 330 kilovolts and 40 kiloamperes requires a testing ability for about 23,000 megavolt-amperes. If we use a short circuit generator that can provide 8 times the specified current to carry ut such tests, the capacity will approach 3,000 megavolt-amperes, equivalent o a generator of 3 million kilowatts. To test a high-tension circuit breaker, almost all of the current generators of the Beijing-Tianjin-Tangshan power network must be utilized. Even when special proofs and measures are used to reduce this capacity to one-tenth the original, we must still establish a special laboratory with 300,000-kilowatt generators. The cost will reach several tens of million yuan. Therefore, among ultrahigh voltage testing facilities, the equipment to test the capability of high-tension circuit breakers to cut off current is a huge and costly endeavor that is even difficult to build by one nation alone. The world's largest KEMA testing station in the Netherlands performs tests for the world's nations and it has become the testing center at present. Its testing capability now exceeds 100 kiloamperes. Our nation has four testing stations (investment ranged from 10 million yuan to nearly 100 million yuan). The largest is the current cut-off capacity testing station of the Xi'an High-tension Electrical Equipment Research Institute.

Besides testing the current cut-off capability of circuit breakers, we must also conduct many other tests of heat generation, dynamic thermal stability, voltage tolerance, mechanical stability and useful life. The number of items to be tested will increase for circuit breakers to be used in special environments. The circuit breaker to be used in situations where the environmental temperature continuously changes has to be subjected to high and low temperature tests. Circuit breakers operating in cold regions will have to be subjected to freezing tests. Circuit breakers to be used in damp and hot regions must be subjected to dampness and heating tests. Circuit breakers to be used in areas at high altitudes above sea level must be subjected to various kinds of voltage tolerance tests under low atmospheric densities--artificial climate laboratory. Circuit breakers used in situations of frequent operation such as electric furnaces in steel mills have to be subjected to duration tests under separate and combined loads of electric currents.

In addition, a circuit breaker should be able to cut off long power lines, electric motors, cables, parallel electrical resistors during no-load runs, no-load transformers and capacitors. It must also be able to cut off various types of malfunctions, such as nearby area malfunctions, different phase grounding, reverse phase cut-off, parallel cut-off and developmental malfunctions.

The Development of the Circuit Breaker

As science and technology develop, the study of the mechanism of extinguishing the arc in the circuit breaker will be more and more profound. There will be a day when the electric arc can be expressed by mathematical formulas with the help of the computer. The testing costs of new types of circuit breakers will be greatly reduced, and more reliable high-tension circuit breakers will become the "sentries" to assure that the power system will operate safely.

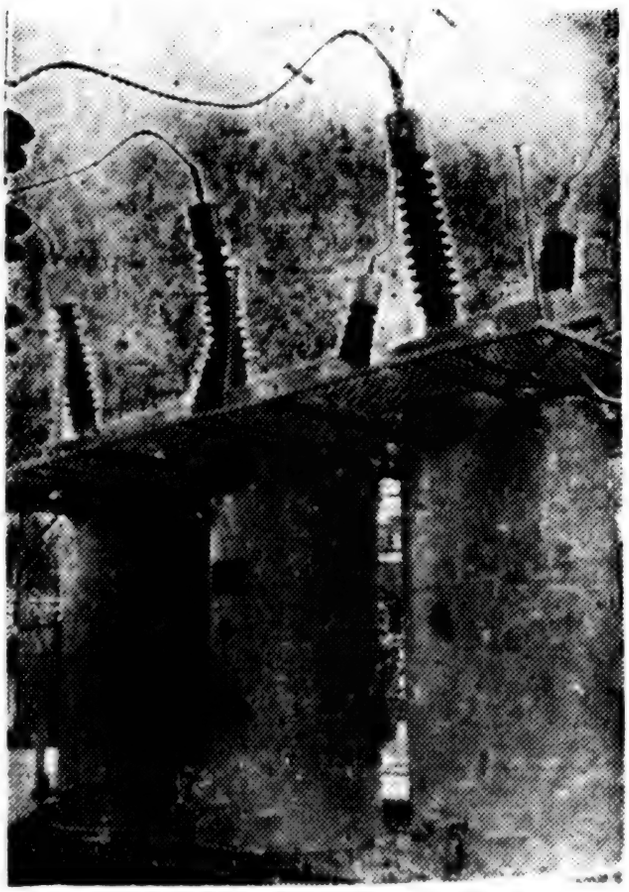


Figure 1. DW3-110 bulk oil circuit breaker.

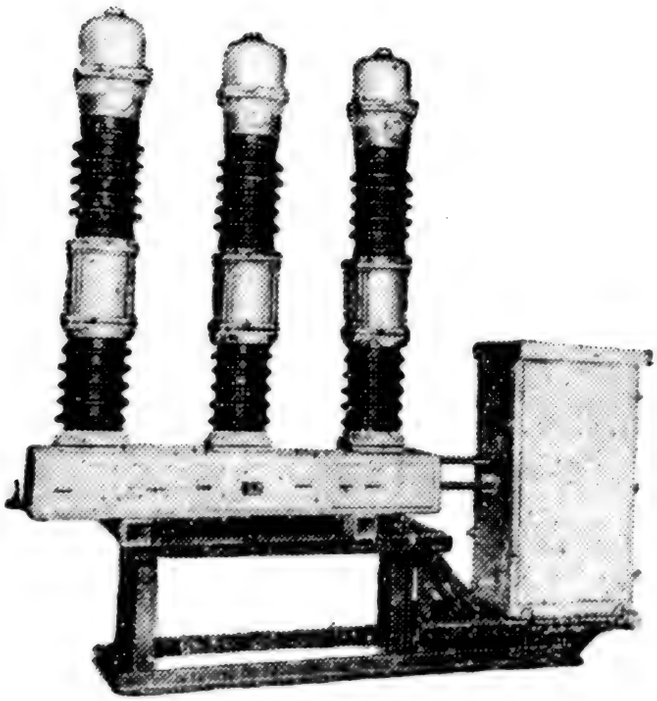


Figure 2. SW2-35 low oil content circuit breaker.

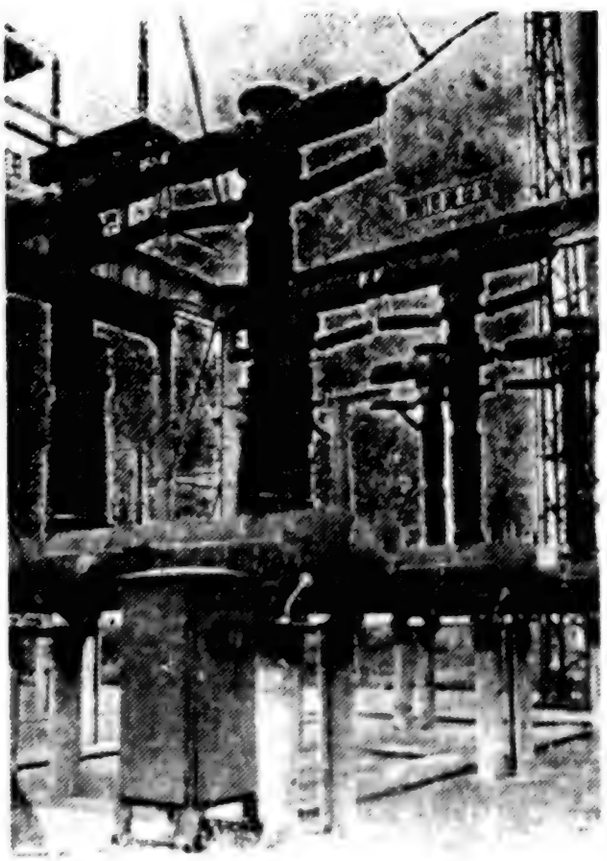


Figure 3. KW5-220 air-blast circuit breaker.

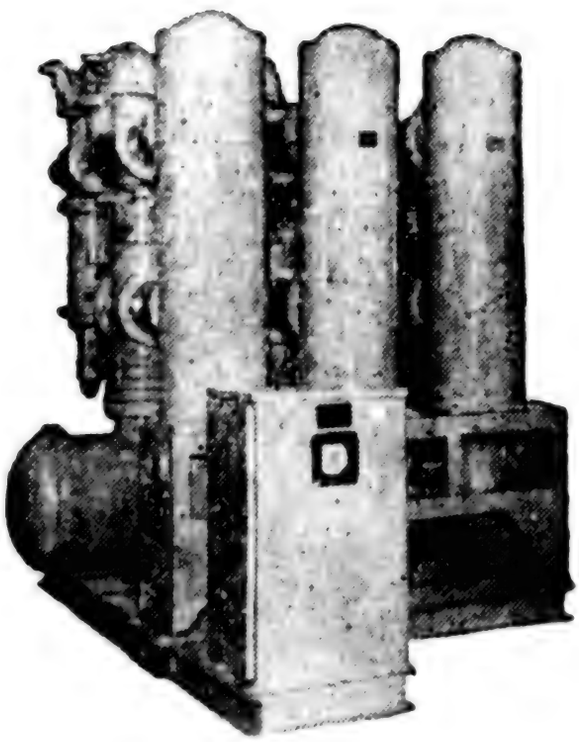


Figure 4. ZF-110 sulphur hexafluoride [SF_6] circuit breaker.

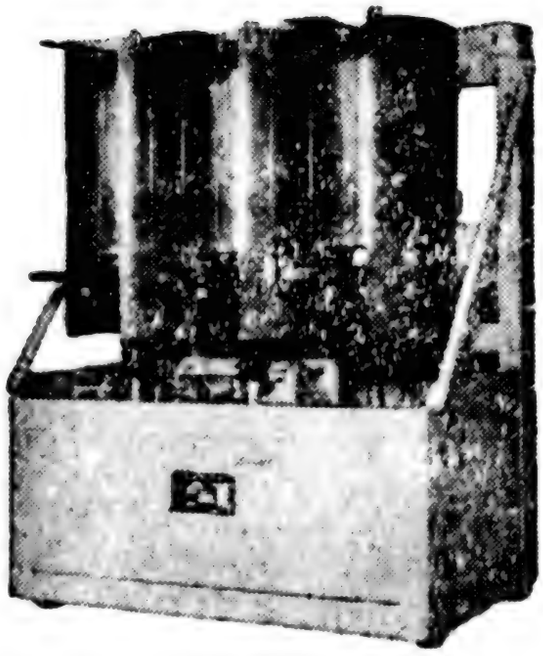


Figure 5. ZN-10 vacuum circuit breaker.

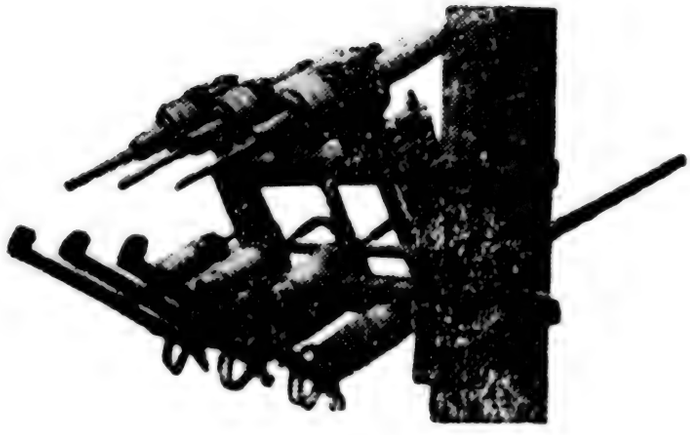


Figure 6. Domestically produced 10-kilovolt air-blast circuit breaker.

9296
CSO: 4013/109

POWER NETWORK

INCREASE REPORTED IN FUJIAN'S ELECTRIC POWER OUTPUT

Fuzhou FUJIAN RIBAO in Chinese 2 Jul 82 p 1

[Article by Office of the Power Industry Administration Bureau, Provincial Department of Hydroelectric Power: "To Meet the Needs of Industrial and Agricultural Production Development, Over 100 Million kWh More Power Was Generated in our Province in the First Half of the Year"]

[Text] The staff and workers of our province's power industry have completed the power generation plan specified by the state for the first half of the year 15 days ahead of schedule. By the end of June, the power network in the province had generated 2.2 billion kWh of electricity, 170 million kWh above the planned figure and an increase of 12.6 percent over the same period last year. The consumption of coal, oil, and electricity was reduced, equivalent to the saving of more than 16,000 tons of raw coal. The up-to-standard cycle rate reached 100 percent. The cost of power generation was lowered and profits passed on to the state increased by 8.3 percent over the same period of last year.

Since the beginning of spring, the momentum for increased industrial and agricultural production in our province has been very good and power consumption has increased greatly, creating a tense situation in power supply. At the time, power production was faced with the difficulties of water shortage for hydroelectric power and coal shortage for thermoelectric power. In order to ease the extreme contradiction between power supply and demand and guarantee the power requirements for industrial and agricultural production, on one hand, the cadres, staff and workers of the power generation and supply units of the province's power network implemented a large safety inspection to take a tight hold on the weak links, develop power generation potentials, transmit the limited supply of power to the consumers safely, evenly, and steadily. On the other hand, under the support and assistance of coal and transportation departments, the supply of coal was actively organized to increase as much as possible the generation of thermoelectric power as a means of making up for the shortage of hydroelectric power.

At the same time, under the prerequisite of guaranteeing safety, economic adjustment was strengthened and the relationship with meteorological departments was refined to keep track, on a timely basis, of meteorological

forecasts in order to have a clear picture of the precipitation conditions, and to make quick and flexible adjustments. Due to understanding the precipitation reports, every opportunity was seized to make adjustments and arrangements and decisively to make available reservior capacities each time rain water was due to reach the reservoirs during the rainy season, particularly during the heavy precipitation month of June. As a result, more water was stored and more power was generated.

5974
CSO: 4013/136

BRIEFS

NEW SUBMARINE POWER CABLE--The Jiaojiang City project involving the laying of a 110,000-volt high-tension submarine cable was completed on 21 August. This large-scale cable-laying project is the first inZhejiang Province. The submarine cable crosses the 1,350-meter-wide Jiao Jiang to connect the Taizhou Power Plant with the electric power system in the southern part of the province and is a "vanguard" in the construction of Jiaojiang City--an important port city in central Zhejiang. It also provides experience for future large-scale projects involving the laying of high-tension submarine transmission lines in our province. The submarine cable project was planned and built by a certain unit of the Navy's East China Sea Fleet, the Jiaojiang City Electric Power Company, the Zhejiang Provincial Electric Power Bureau, the Taizhou Electrical Industries Bureau, and other units. The project was carried off without a hitch, taking only 18 days to complete. [Text] [Hangzhou ZHEIJAING RIBAO in Chinese 31 Aug 82 p 1]

CSO: 4013/8

WATER-COOLED TURBINE--The 300,000-kilowatt double inner water-cooled turbine generating unit is currently our country's largest capacity thermal generating equipment produced domestically. The design of the unit was completed in 1969 and trial manufacture was completed at the end of 1971. The unit installed at the Yaomeng Power Plant joined the net for power generation in September 1975. The two units installed at the Wangting Power Plant joined the net for power generation in September 1974 and September 1976 respectively. Based on the operating experience of the power plants and through the organization of forces to cooperatively tackle key problems by the Ministry of Power, the First Ministry of Machine Building Industry, and the Shanghai economic committee and the continuous efforts of the design, scientific research, manufacturing, installation, and operating units, the generating units have been continuously improved and their levels of safety, steady power generation, and economic operation have been raised. For instance, the first unit, which is a coal-burning unit installed at the Yaomeng Power Plant, exceeded 6,600 hours of operation in both 1979 and 1980 and generated over 1.7 billion kilowatt hours of power each year. After improvements, the average operating time of the two oil burning units at Wangting reached 7,619 hours in the 2 years of 1979 and 1980. They generated a total of more than 8.1 billion kilowatt hours of power in the 2 years. The highest instantaneous power generation once reached 310,000 kilowatts. The average load was 266,000 kilowatt hours. The longest continuous operation was 138 days and power network participation was

93.5 percent. Another 300,000 double inner water-cooled unit was installed at the Jianbi Power Plant in 1980. From December 7, 1980, when it first started its trial operation and joined the power net, to September 20, 1981, it operated a total of 5,415 hours and generated 1,243 million kilowatt hours of power. The longest continuous operating time was 1,496 hours. Before the high pressure heater was placed in operation, the coal consumption had already been lowered to 338 grams/kilowatt hour. The vibrations of bearing axles are all below 0.02 millimetes. [Text] [Shanghai DIANSHIJI [ELECTRICAL WORLD], No 1, 1982, p 35] 5974

CSO: 4013/108

ELECTRICITY OUTPUT--Beijing, 26 Jun (XINHUA)--China has exceeded the semiannual goal for electricity output, according to the Ministry of Water Conservancy and Power. The ministry said that up to yesterday 155,200 million kwh of electricity was produced, 3,100 million kwh above the seminanual plan and 7.4 percent above the same period of last year. The power shortage has not been eased, the ministry said, and it urged all to continue to economize in the use of electricity. [Text] [Beijing XINHUA in English 0721 GMT 26 Jun 82 OW]

CSO: 4010/12

GANSU REPORTS RECORD POWER OUTPUT--[Article by Tang Jinsheng [0781 6855 3932]: "Record Power Output During January-May Is Achieved in Our Province"] The broad number of workers of our province's electric power department has raised their spirit and overcome difficulties and exerted efforts to improve economic gain. During the first 5 months of this year, power output has created the best level in history. At the beginning of this year, the provincial Electric Power Industry Bureau arranged the production plan and repeatedly emphasized that work must be centered around safety and the improvement of economic gain. During the first 5 months, it rationally arranged the mode of operation, strengthened economic dispatching of the power network, and fully developed the superiority of hydroelectricity. The whole province completed an output of 5.15 billion kwh, an increase of 12.45 percent over the same period last year. In particular, hydroelectric facilities generated an additional 630 million kwh of electricity, an increase of 22.6 percent over the same period last year. This item alone conserved 300,000 tons of coal and increased profit by more than 20 million yuan. The output of electricity from January to May not only can satisfy our province's industrial and agricultural needs for electricity, [illegible] also avoid the passive situation of limiting the use of electricity dur[illegible]ak consumption in May and June which has continued for 2 years. The amount of electricity transmitted to other provinces has also increased by a large scale over the same period last year. At the same time, because operational management of the reservoir was strengthened, the percentage of water loss dropped. Incoming water during the dry season this year was good, and the amount of water released to Nei Monggol, Ningxia, Henan, Shandong at the middle and lower reaches of the Huanghe was increased. Supplementary water also increased over past years. This has created good conditions for the generation of electricity in the provinces and regions at the middle and lower reaches and for the use of water by industries and agriculture. [Text] [Lanzhou GANSU RIBAO in Chinese, 6 Jun 82 p 1] 9296

CSO: 4013/120

HUNAN POWER INDUSTRY--Hunan's power industry has made steady progress amid readjustment. From 1979 to the first half of 182, the province installed a number of generators sets of 500 kw or more and some power transmission and transformer equipment. These items have increased power output by 3 billion kwh and played a major role in easing the province's power shortage and developing the national economy. From 1979 to the end of June 1982, the province spent 640 million yuan on power industry construction. [Changsha Hunan Provincial Service in Mandarin 2310 GMT 25 Aug 82 HK]

NEI MONGGOL POWER SUPPLY--According to statistics released by the Nei Monggol Regional Power Bureau, of the region's 1,580 communes in the rural and pastoral areas, some 1,030 now have electricity. In 1981, electricity for agricultural use reached 900 million kwh, one-fourth of the total electricity supply for both agriculture and industry. By the end of 1981, some 182 transformer stations with a total capacity of 500,000 kilo-volt-ampere, high-tension transmission lines totalling 46,000 kilometers and high-tension lines totalling 55,000 kilometers were built and installed in the rural and pastoral areas. Now 74 banners and counties in the region have electricity, 83 percent of the region's total. A fair-sized power network has taken shape in the region's rural and pastoral areas. [Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 22 Aug 82 SK]

HEILONGJIANG POWER OUTPUT--In the first half of 1982, Heilongjiang Province generated an additional 2.8 billion kwh of electricity over the corresponding 1981 period, an increase of 24 percent. The province reduced the consumption of standard coal by 22 grams in generating 1 kwh of electricity, saving 260,000 tons of standard coal in 6 months. Since the third plenary session, this province has increased power generation sets totalling 510,000 kw, an increase of 22.7 percent over 1979. It has newly constructed 420 km of high-voltage power transmission lines and increased transformers with a total capacity of 690,000 kilo volt-ampere. Compared with corresponding 1979 period, power consumption increased in the first half of 1982, of which power for agriculture increased 39.1 percent, for light and textile industries 23.1 percent, for energy industry 20 percent, for building materials industry 38.4 percent and for people's daily life 47 percent, a total increase of 2.75 billion kwh or 27 percent. [SK181252 Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 17 Aug 82]

JILIN ELECTRICITY--Since the third plenum, Jilin Province's power departments have achieved good economic results. In 1981, they generated 3.1 billion kwh more electricity than in 1978, an increase of 30 percent and an average increase of 10 percent every year. Local small hydroelectric powerplants showed more than a 100 percent increase in electricity production in 1981 compared with 1978. The consumption of coal for generating 1 kwh electricity has been reduced by 5 grams every year since 1978. Oil consuming powerplants have made efforts to conserve oil and have used more coal instead. Their oil consumption in 1981 was less than in 1978. Accidents in the powerplants of the province in 1981 also declined 35 times compared with 1978. [Changchun Jilin Provincial Service in Mandarin 1100 GMT 23 Aug 82 SK]

SHANDONG POWER PLANTS--In the past 3 years, three power plants--(Sanhua), (Shiliquan) and (Huangdao) power plants--with a combined installed capacity of 1 million kw have been built in Shandong Province. Meanwhile, extra-high-voltage transmission lines of 110,000 volts or higher with a total length of 1,900 km were erected throughout the province, thus forming a unified power grid. The province's present power generating capacity and the length of extra-high-voltage transmission lines increased by 26 percent and 48 percent respectively over the 1978 figures. Power consuming communes increased from 85.5 percent in 1978 to the present 91.3 percent in number. In the past 3 years, the profits and taxes handed over to the state by these three power plants have been more than 50 percent of the total investments. [SK121050 [Jinan Shandong Provincial Service in Mandarin 2300 GMT 10 Aug 82]

SHANDONG POWER FOR AGRICULTURE--Since the third plenary session, Linyi Prefecture, Shandong Province, has paid attention to expanding power transmission for agricultural use. In the past 3 years, the prefecture has added 6,085 km of transmission lines for agricultural use. The prefecture's 1981 agricultural power consumption rose 2.1 fold over 1978. [Jinan Shandong Provincial Service in Mandarin 2300 GMT 30 Aug 82 SK]

CSO: 4013/138

GUIZHOU INCREASES ELECTRICITY OUTPUT--By 20 June, the electricity grid of Guizhou Province had generated 2.38833 billion kwh of electricity and fulfilled 50.46 percent of its quota for electricity output for 1982. Its electricity output in this period was 527.47 million kwh more than in the corresponding period of last year. This electricity grid submitted profits of 51.84 million yuan to the state, which were 8,84 million yuan more than in the same period of last year. The amount of coal consumed for the generation of each kilowatt hour of electricity from January to May this year was 6 grams lower than that in the plan for 1982. The electricity grid saved a total amount of 9,702 tons of standard coal. The electricity loss rate was 1.29 percent less than that in the plan for 1982 and the electricity grid saved 22.1 million kwh. [Guiyang Guizhou Provincial Service in Mandarin 2315 GMT 4 Jul 82 HK]

SHANDONG POWER STATION--The construction of the (Shiliquan) power station, [illegible] of the [illegible] in Shandong Province, has been completed and put into production. On 20 July a rally was held to mark its completion. Song Jimin, vice governor of the Shandong Province, addressed the rally. The power station lies in the Zaozhuang coal field on the southern outskirts of Zaozhuang Municipality. This power stationhas four 125,000-kw generating units and the total capacity is 500,000 kw. The four generating units have been put into production respectively in 1979, 1980, 1981 and 1982. The construction cycle took 49 months, 1 year ahead of schedule. The first three generating units have generated over 4.3 billion kilowatt hours of electricity, handing over 140 million yuan of tax and profits to the state--57 percent of the total investment. [SK212230 Jinan Shandong Provincial Service in Mandarin 2300 GMT 20 Jul 82]

GANSU POWER OUTPUT--The Liujiaxia hydropower plant generated nearly 600 million kwh of power in June, overfulfilling the monthly output plan by 17 percent and generating 185 million kwh of power more than in the corresponding 1981 period. [Lanzhou Gansu Provincial Service in Mandarin 1125 GMT 1 Jul 82 SK]

HENAN ELECTRICITY OUTPUT--By 22 June, the Henan provincial electric power front had generated 8.5 billion kilowatt-hours of electricity and fulfilled its quota for generating electricity for the first half of this year 8 days ahead of schedule. [Zhengzhou Henan Provincial Service in Mandarin 1100 GMT 28 Jun 82 HK]

GUANGDONG POWER OUTPUT--Guangdong generated 6.4 billion kwh of electric power in the first half of this year, 14.3 percent more than in the same period last year. Profits increased by 17.6 million yuan, a rise of 20.8 percent. Consumption of coal, water and power in the power plants was the lowest ever recorded for the period. This success was achieved despite reduced supplies of fuel for the thermal power plants and of water for the hydroelectric stations during the period. Everything possible was therefore done to reduce input consumption and improve equipment efficiency. [Guangzhou Guangdong Provincial Service in Mandarin 1000 GMT 8 Jul 82 HK]

JILIN POWER INDUSTRY--The power industrial plants in Jilin Province earned 49,49,480,000 yuan of profits in the first half of 1982, fulfilling their annual plan by 60.3 percent. Our province respectively witnessed 4.6 percent and 4.4 percent increases in the semiannual power supply and heating supply over the figures of the corresponding 1981 period. [Changchun Jilin Provincial Service in Mandarin 1100 GMT 12 Jul 82 SK]
CSO: 4013/132

QINLING THERMAL POWER PLANT--The second stage project of the Qinling Electric Power Plant--the largest thermal power plant in the Northeast now under construction--is being accelerated. The No 1 generator, with an installed capacity of 200,000 kilowatts, has already been installed. Participants in the construction--the Northeast Electric Power Construction Company and the Shaanxi Third Construction Company--are implementing the spirit of the 12th Party Congress and intensifying the construction work in an effort to have the No 1 generator on stream before the end of the year. The second stage project of the Qinling Power Plant is one of the nation's most important construction projects. The projects call for the installation of another [No 2] generator which also has an installed capacity of 200,000 kilowatts. The first stage, already finished, has an installed capacity of 250,000 kilowatts. The Qinling Power Plant is located in Huayin County in the eastern part of the Guanzhong Plain on the Nanyi-Longhai Railroad. Transportation is convenient, water resources are abundant and use can be made of the coal from the Weibei coal fields. [Text] [Beijing RENMIN RIBAO in Chinese 3 Oct 82 p 4]

NINGXIA THERMAL POWER PLANT--Ground was recently broken on the first large-scale pit mouth electric power plant in the Ningxia Huizu Autonomous Region--the Dawukou Power Plant. The Dawukou Power Plant project will have four 100,000-kilowatt generators for a combined installed capacity of 400,000 kilowatts. The yearly output will reach 2 billion KWH. [Text] [Beijing RENMIN RIBAO in Chinese 6 Oct 82 p 1]

CSO: 4013/16

[illegible] VOLT TRANSMISSION LINE--By 18 August, China's first 330,000-volt line, the Liutianguan line, had safely operated for 1,910 days, creating a record in the electric power grids of the electricity supply department of Gansu Province. This ultrahigh voltage power transmission line, which is situated inside Gansu Province and is maintained by the Tienshui Electricity Supply Bureau, constitutes one of the trunk lines of the northwest electric power grid. It runs from the Liujiaxia power station through nine counties of Gansu Province to Shaanxi Province. More than 300 km of the Liutianguan line and its facilities are in the mountainous area where the geographic conditions are interior and the system is prone to natural disasters including storms and mountain floods, making it very difficult to supply electricity safely through this line. After the Seventh Plenum of the Party Central Committee was held, a group led by the chief of Electricity Supply Bureau and the chief engineer visited and carried out safety inspections of every transformer station and the line and also conducted safety education, determined to welcome the 12th Plenum with new achievements in the safe supply of electricity. [Text] [Lanzhou GANSU RIBAO in Chinese 25 Aug 82 p 1] 9113

CSO: 4013/166

CONFERENCE FOCUSES ON WAYS TO ACCELERATE HYDROPOWER CONSTRUCTION

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 7, 12 Jul 82 pp 3-4

[Article: "A New Start in Quickening Hydropower Development--A Meeting on Hydropower Construction Projects Held in Beijing"]

[Text] From 3 to 9 June 1982, the Water Conservancy and Hydropower Construction Company held a water conservancy and hydropower construction working conference in Beijing. Delegates from subordinate construction bureaus (companies, plants, stations), river valley agencies, the survey and design institute, the command headquarters of the capital construction engineering corps, the troop units of the engineering corps, related provincial (regional) hydroelectric power construction bureaus, command headquarters, and design institutes attended the conference. Comrades of the State Economic Commission, the National Hydroelectric Power Union and related departments and bureaus of the Ministry of Water Conservancy and Electric Power were invited to attend the conference. This is the first conference held since founding of the parent company. It signified the great gathering and great unity of the water conservancy and hydroelectric work teams and it also signified the beginning of the new long march in building water conservancy and hydroelectric power. During the conference, Minister Qian Zhengying [6929 2973 5391] made an important speech. Comrade Wang Ganguo [3769 1626 0948] delivered the working report. Comrades Zhang Bin [1728 1755], Liu Shutian [0491 2579 3944], Li Eding [2621 7725 7844] and Zhang Tiezheng [1728 6993 6927] spoke. Comrade Chen Gengyi [1775 6342 0308] delivered a summary of the conference.

The central task of this conference was to implement the spirit of the national work exchange conference and the national electric power working conference, summarize the work done in 1981, assign the tasks of overall reorganization centered around improving economic gain and the surveying, design and construction tasks of 1982.

Delegates discussed fully and unanimously believed that the guiding ideology of this conference was clear, the problems studied were centralized, and the conference was effective. Everyone was determined to lift up his spirit and exert efforts to build up the teams, to improve business management closely centered around improving economic gain, reorganize and perfect the economic responsibility system and complete this year's plans on an overall basis.

[illegible] followed the main [illegible] talk by Minister Qian and emphasized the [illegible] of how to quickly build up hydropower. Everyone believed: (1) First, we must concentrate forces in construction to develop gains as quickly as [illegible]. Gezhou-ba, Longyangxia, Baishan, Panjiakou, the project to divert [illegible] line to transport water, and the Wujiangdu and Nanyu he projects [illegible] projects that will begin operation this year or will be able [illegible] produce a gain in the near future. Construction must be organized well and the quality of construction must be guaranteed. The five generators at the Jiang Power Plant of the Gezhou-ba Project should be completely installed [illegible] this year or next year. Digging of the base tunnel of Dajiang should be [illegible] completed within the year and the pouring of concrete structures should begin on an overall basis this year. We must guarantee that the first generators at Baishan and Dahua begin to generate electricity next year. The [illegible] of pouring concrete for the power plant and the dam of the Longyangxia [illegible] must be done well. Efforts must be exerted to hasten progress to ease the threat of flood waters as early as possible. While the generators at Wujiangdu and Nanyu he are actively beginning production this year, they must [illegible] the finishing work well. Panjiakou must hasten its work in finishing [illegible] construction to guarantee the task of supplying water. The second task is to hasten preparations for construction of such new projects as Lubuge, [illegible], Jin Sha Jiang, Houzui, Laijiawan, Tongjiezi, and the second cascade [illegible] so that the main body of construction can be started early and [illegible] of the river bed can begin early. The other task is to hasten [illegible] of projects in the final stages so that they can be completed and delivered early and so that forces can be concentrated in new projects.

We should [illegible] and establish strategic arrangements in planning and [illegible] work for the development of hydropower throughout the nation and [illegible] the number of backup projects. River planning is a strategic arrangement of water [illegible] and hydropower construction. It affects the major [illegible] of managing our nation's territory and developing energy. It must be [illegible] sufficient attention. At present, an urgent task is to plan and select [illegible] in the Jinsha River and the upper reaches of Huanghe. We must tightly [illegible] the preparation of research reports on the plans. Each designing unit [illegible] prepare designs and make designs for the construction of projects currently [illegible] construction. [illegible] designs, supplementary designs and their [illegible] studies [illegible] arranged should be carried out according to schedule. [illegible] should study and establish a basic policy to hasten the development of [illegible], such as policies to distribute economic gains, policies to gather [illegible] capital, [illegible] policies, [illegible] to facilitate mobilizing the enthusiasm of all [illegible] in developing hydropower. [illegible] We should actively open up sources [illegible] capital. We should encourage local investment and implement joint ventures [illegible] state and local authorities to build hydropower. We should also actively [illegible] favorable circumstances to gradually expand the scale of hydropower [illegible]. [illegible] should organize construction according to a rational [illegible] schedule. When a project is started, investment must be arranged [illegible] according to the general progress of the project. The supply of materials [illegible] equipment must be organized well and construction must be carried out in [illegible] order. [illegible] to properly solve the external relationship of cooperation, such as

requirement of land and moving the inhabitants, navigation, movement of timber, highway transportation, railroad branch lines, and telecommunications lines to create conditions for design and construction. (7) We must care about the life of the workers, actively build up bases in the rear. The bases must be combined with some production and training centers so that they will benefit the stabilization of the teams of workers and benefit construction at the frontlines. (8) We must strengthen political and ideological work, improve the style of leadership, strengthen the build-up of the teams themselves, improve the standard of scientific and technical operation of the teams, develop the superior tradition to become a broad minded, pragmatic, advanced, hard working, idealistic, moral, cultured, disciplined army to build up water conservancy and hydropower. In general, it is hoped that this conference will become the new starting point for hastening hydropower build-up so that our nation's hydropower will be done better and faster and develop more prosperously.

12946
CSO: 4013/129

WAYS TO SHORTEN CONSTRUCTION TIME FOR LARGE PROJECTS EXAMINED

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 5, 12 May 82 pp 4-7

[Article by Liao Canyue [1675 3605 6885] of the Hydropower Command Post of the Capital Construction Engineering Corps: "On the Feasibility of Shortening the Period of Construction of Large Projects in View of Panjiakou Reservoir's Storing Water and Generating Electricity Ahead of Schedule"]

[Text] The Panjiakou Reservoir is a large key project for the development of the Luan River, for meeting the industrial, agricultural, and urban water needs of the Tianjin and Tangshan areas, for increasing the peak capacity of the Beijing-Tianjin-Tangshan power network, for improving the quality of power supply, and for preventing floods. The reservoir's total storage capacity is 2.93 billion cubic meters, and the total installed capacity of its power stations is 450,000 kw (its 1 regular generating unit has an installed capacity of 150,000 kw, and its 3 water-pump storage generating units have an installed capacity of 300,000 kw). The reservoir is the hub of an axis mainly composed of the power stations at 1 large dam on the Luan River, 2 auxiliary dams, and 1 backup dam. The large concrete dam is 1,040 meters long, and the largest dam is 107.5 meters high. In the first stage of the project (excluding the lower pool floodgate and the three storage units), 4.2 million cubic meters of earth and stone were excavated, 1.8 million cubic meters of earth and stone were filled in, and 3 million cubic meters of concrete were poured. The initial design set a time limit of 8 years for the project with an investment of 680 million yuan. The project was designed by the Tianjin Survey and Design Institute. Unit 00619 of the Capital Construction Engineering Corps has undertaken the task of building it, and an installation team of the Fifth Bureau of the former Ministry of Water Conservancy is responsible for installing the 150,000-kw regular generating unit.

Surveying work on the site of the present dam in this key project began in September 1973. By the end of that year the site has been chosen, and in 1974 a preliminary design had been completed. In October 1975, work began on the main part of the project. In 1979, 1 year ahead of time, water was stored in the reservoir, and the power station's first 150,000-kw generating unit began generating electricity in December 1980, 1 year ahead of time. Tests on the water stored and the electricity generated by this project have shown

them to be of good quality, and beneficial results have already been produced by the project. Owing to the hard work of the construction unit, over the past several years the project cost has been lowered by 3.32 million yuan; it is estimated that, after the first stage of the project is finished, million as compared with the budgetary estimate, 50 million yuan will have been saved, and compared with the design, 70,000 fewer cubic meters of wood and 10,000-odd fewer tons of steel will have been used.

With regard to the amount of concrete for a project, the Panjiakou project occupies third place among our country's water conservancy and hydropower projects. At the present dam site, from the beginning when the first hole was drilled to the storage of water when the reservoir's lower floodgate was opened, the design and survey work took 1 year 4 months' time and the construction of the main part of the project took 4 years 2 months' time. This was a relatively fast rate of construction. Seeing that reducing the construction period for big hydropower projects and improving returns on investments is a big issue related to various aspects at present this article, drawing on the practice of the Panjiakou Project for its foundation, will discuss the understanding and knowledge gained from experience in this respect.

1. Doing Good Work in the Early Stage by Closely Coordinating Procedural Work, Design and Construction

The key to early-stage work, besides proceeding from reality and formulating rational plans, is to do good surveying work and select good dam sites; otherwise, it is possible that a situation will arise in which after construction begins problems will be discovered and have to be dealt with, thereby incurring losses by extending the time limit for completion of the project. One very important reason that the Panjiakou project made relatively fast progress was that in the early stage of the work the designing and construction cooperated closely and, through doing large amount of survey work and giving overall consideration to the terrain, surface features, and construction conditions, good dam sites were chosen.

The Luan River is one of North China's rivers with a comparatively plentiful amount of water, the annual average amount of runoff being 4.6 billion cubic meters. As early as the period of the Japanese puppet regime, survey work began at Panjiakou Gorge on the mainstream near the old Great Wall. After liberation, according to the general understanding, a dam site in this narrow river valley would involve a small project, with the result that the geological conditions would be complex, but, not willing to abandon the idea, people continued to survey the site. In 1973, in order to accelerate the early-stage work on the Panjiakou project, the construction unit, in line with a decision made by the then Ministry of Water Conservancy and Electric Power, joined forces with the designing department to form a "battle" command post. People of the two departments stayed at the site together, unified the command, supported each other, and closely cooperated with each other. From September to December 1973, they did a lot of additional exploratory work

of the old dam site, and at the same time found the present dam site, which [illegible] kilometers below the old dam site, and ascertained the geological conditions there. On the basis of a lot of geological work and demonstrations and [illegible] comparing the two dam sites, they unanimously concluded: Although the river valley at the old dam site is narrow and thus, from a terrain standpoint, a project there would be small, the geological conditions there are poor. Each layer of quartz rock, which is about 80 cm thick, is pressed on both sides by a slowly inclining angle mud layer. To provide a good foundation, it would be necessary to dig a deep base for the dam, and the project would double and redouble in size. At the same time, a tunnel to divert the water would have to be built. The construction would be difficult to arrange. Therefore, a project on the old dam site would not appear to be economical and it would also be difficult to insure its completion within the time limit. And, at the newly selected present dam site, although the river valley is, by comparison with the old dam site, wider and the project bigger, it has many advantages, the main ones being: 1) geological conditions are good, so that the large dam could be built on a higher base, thereby reducing the amount of digging needed; 2) the construction site is wide, so that cofferdam diversions could be used in stages, and the site is advantageous for the deployment of large machinery, thereby raising the degree of mechanization; 3) communication with the outside would be convenient, sand and rocks could be obtained nearby, and equipment and materials could be brought directly to the dam; and 4) the reservoir storage capacity could be expanded by about 300 million cubic meters. Precisely because this dam site was chosen, after work began no big geological problems were discovered, the laying of the dam base was not complicated, and there were no big changes in the design. In addition, it was possible to carry out the construction in an overall manner. Thus, fundamental conditions were created for shortening the period of construction of the Panjiakou project and its benefits were felt ahead of schedule.

II. Rationally Organize the Construction Plan, Appropriately Reducing Temporary and Auxiliary Projects, and Making a Point of Adopting New Technology

The construction plan for the Panjiakou project was drawn up by the construction unit. Owing to the construction personnel's understanding of their own ranks, equipment, and technical level, the construction plan that was drawn up was relatively suited to reality and the construction arrangements were relatively rational. They took into consideration the fact that the temporary and auxiliary projects were only means of completing the main part of the project. Therefore, when drafting the construction plan, in line with the principle of proceeding from reality, they made careful calculations and carried out strict budgeting, appropriately reducing the temporary and auxiliary project so that this way of thinking and acting played a marked role in accelerating the rate of construction and in saving investment. For example, Panjiakou Reservoir's large dam is a three-level structure, and the project for grooved cofferdam on the main river was originally designed with year-round construction in mind. Therefore, in line with standard requirements, a plan was adopted for year-round diversion of floodwaters encountered once in 20 years. Then the construction unit combined the characteristics of the Luan River and carried out an analysis: 1) its flood peak is high. If there were to be a year-round diversion of the flood water encountered once in 20 years, then during

the flood season the flow rate for the safe passage of water would have to be 11,800 cubic meters per second. Thus the scale of the diversion project would be large, and it would require an investment of over 10 million yuan and close to 1 year to build the vertical concrete cofferdam and the horizontal earth and stone cofferdam. 2) The flood season is short. Ordinarily the flood season of the Luan River occurs in July and August, and the big flood season occurs in the last 10 days of July and the first 10 days of August. If the low-water season could be used to concentrate forces on taking the water retained by the main river channeling concrete base pit and letting it pass through in the flood season, then the time needed for construction of the main river channeling dam would at the maximum be only 3 months. And, according to the flow rate once in 20 years during the low-water season being only 1,400 meters per second, the project amount for the cofferdams would be greatly reduced. Based on the above analysis, in order to cut down on temporary construction and devote more effort to the main part of the project, they decided to adopt a diversion plan based on the low water season encountered once in 20 years. Precisely [illegible] they used measures suited to the characteristics of the Luan River and gave play to the youth and vigor of the construction contingent; they were able to take advantage of the contingent's superiority in doing a rush job, with the result that within one low-water season they trapped the flowing water 56 days ahead of schedule in the main river's channel concrete base pit, safely got through the high-water season, saved about 5 million yuan in investment, and opened up a new situation for accelerating the main part of the project. Also, in the construction of Panjiakou's big dam, 10-ton gate cranes were used to pour concrete. Because of the expenditure of labor and materials in the initial design plan for erecting a landing stage, the time period for early-stage work would have been long, the construction unit, synthesizing its own characteristics, called off the construction of the three lock mechanism landing stages, which would have been over 20 meters high each and 1,650 meters long in aggregate for the dam structure in the lower reaches, which had originally been designed, so that the large concrete dam was built without landing stages. The lock mechanism, 120-odd tons deadweight, generally required 30-odd hours to raise up and dismantle on the concrete dam, the fastest time being 28 hours, and thus by saving the time needed to erect landing stages 7 million yuan in investment were saved. Again, for example, for the sand and stone quarries, in the original preliminary design, besides the existing quarries, it was decided to open up the Jijia Pit quarry located over a dozen kilometers below the large dam on the left bank of the river's lower reaches. But the construction unit maintained that this not only would require a hydropower installation and temporary buildings but also would mean the building of a dozen kilometers of light-track railway and the provision of additional auxiliary transport equipment, and thus the cost would be high. Based on this situation, they decided to make full use of the existing quarry by force-pumping water and having excavators dig 4 cubic meters deeper so as to solve the problem of insufficiency of sand and stone. The result was that they both accelerated constructing the project and saved 1 million yuan a year in investment.

In addition, the construction unit made a point of using new technology and the fruits of technological innovation. For example, for the surface of the [illegible] walls, each about 60 meters high with an aggregate length of 324 meters, construction turnouts by slide shuttering was used throughout; additional agents and powdered coal ash were mixed with the cement; for coiling the dam's structural concrete and for join-seam grouting, plastic draw-pipes were used; when pouring the concrete for the dam body, fixed-pattern steel shuttering large-pattern

[illegible] and prefabricated concrete corridors were used; during construction in the winter, gravelite was sprayed on the concrete surface to preserve heat; [illegible] all of which produced marked results in raising work efficiency, [illegible]mizing on the "three materials" [cement, wood and steel], lowering construction costs, and improving quality. For example, just by mixing wood fibers and powdered coal ash in with the concrete, close to 50,000 tons of cement were saved; for the entire project, 70,000 cubic meters of wood and over 1 ton of steel were saved.

Strengthening the Building of the Ranks, Increasing the Fighting Capacity of the Army

Unit 00619, which undertook the Panjiakou Reservoir construction project, is a unit of the Capital Construction Engineering Corps. The number of the dependents at the construction site were only about one-tenth of the number normally at a hydropower construction enterprise; at the same time the youth and vigor of the construction contingent meant that it could bear hardships and stand hard work, adapt to arduous conditions, and be able to move swiftly, all of which is of advantage in doing crash jobs. But, owing to the disruption and destruction during the 10 years of internal disorder, the construction by this contingent was greatly affected, and its technological level and its capacity for construction and production dropped markedly. When work on the project began, there were only slightly more than 200 technical cadres in all, and the average technical grade of the workers and fighters was less than the 1.5 grade; on top of that, the contingent charged with the task of constructing the large concrete dam, which had originally worked mainly on underground projects when it was in Sichuan, not only had inadequate technical forces but also was very unsuited to the work.

In view of the above-mentioned situation, Unit 00619, from the beginning of the construction project, exerted itself to build up the contingent in the following respects. It readjusted the leading group, reorganized the organizational structure, and, in line with the special feature that there was a high degree of concentration at the construction site of the Panjiakou project, streamlined the administrative organs and reduced the number of nonproductive personnel, so that they were kept at less than 20 percent of the total number of personnel, in order to raise the construction level and work efficiency. It took many measures, such as sending people out and inviting people in, conducting training, [illegible] specialized technology, having the veterans lead the recruits, and launching [illegible] on-the-job training and technical competitions so as to train a large [illegible] of talented persons in specialized technology. For example, on the 8km-meter-long special railway line that runs from Zunhua to the construction site, when the unit was about to begin using the seven standard-track locomotives it did not have a single locomotive driver or fireman. The unit sent several [illegible] fighters with relatively high educational levels to [illegible] units for 3 months of study, and thus insured normal movement [illegible] time. Also, for example, the unit lacked operators for the 10-ton [illegible] that would pour concrete. It requested instructors to come and train, and the [illegible] intensively mastered this technique. The 19 large

gate cranes and tower cranes were operated with agility, and each shift on each machine hoisted 252 buckets of concrete into storage. Because the above-mentioned series of measures were taken, the fighting capacity of the contingent was greatly strengthened. It now possesses over 500 technical cadres, and the technical grade level of the fighters and workers has been raised to the 3.2 grade, thereby providing organized support for accelerating the construction of the project.

IV. Strengthening Administration and Management, Vigorously Displaying Subjective Activity, and Getting a Tight Grip on Progress of the Project

The Panjiakou Reservoir project is a key construction project, but it is limited by the state's financial and material capacity. Every year there are gaps in the investment and materials planned and arranged, and it is hard to satisfy the requirement for a fixed time limit for completion of the project. However, in order to accelerate construction and to display the benefits of the project as soon as possible, the construction unit, not limiting itself to the targets [illegible] planned and arranged at the beginning of the year, actively [illegible] subjective activity by working hard to pre-overfulfill the targets [illegible]. Their ways of doing things are: 1) they make allowances for the state's financial difficulties and, based on the order of importance and urgency on the project, as much as possible use the limited investment and "three materials" to insure key points and to not fight a "war of attrition"; 2) they vigorously think of methods of reducing the number of temporary structures and auxiliary projects and of lowering the cost of the project, so that less money is spend and more work is done; 3) they take the initiative to tap their internal stocks and, as much as possible, avoid asking the state for help; and 4) they make regular reports on the situation to the higher level, report on the progress of the project, and try to get support from the leading organization. In this way, in the years in which the investment was insufficient, they prefulfilled quotas; in the years in which the original investment was increased, they overfulfilled quotas. At the same time, they took the greater part of the funds saved by lowering the cost of the project and put it into the work load.

In order to turn over a new leaf in the Panjiakou project and not let the struggle targets put forward at the beginning of the project of "catch the water a year ahead of schedule, store the water ahead of schedule, generate electricity a year ahead of schedule, and save 90 million yuan in investment" come to naught, they took a series of measures to strengthen administration and management: First, when arranging the construction tasks for every year, every quarter-year, and every month, they always, according to the above three demands for completing the project ahead of schedule, tied each link of the plan tightly together in their overall relation to fulfill them on time. In order to insure the "three material elements," the principal leading cadres at each level assisted in [illegible] control at the first line of construction and production, timely discovering the [illegible] problems and not letting the project tasks fall behind schedule.

, it generally set up and perfected various rules and
regulations. For example, in 1977 they set up a project plan control system
[illegible] leadership and a technical management system
[illegible] the project's chief engineer, and at the same time they reorganized
[illegible] assignment of materials, equipment, and funds. In 1978,
[illegible] a three-point provision for economic accounting and put
[illegible] labor quotas and material quotas for the entire year. In 1979, they
[illegible] a straight-line calculation drive and the management of returned
[illegible] and tools. In 1980, with eight technical and economic targets as the
[illegible], they launched competition and assessment activities for the awarding
[illegible] and title; in each enlistment's joint operations, they vigorously popularized
the system of internal budget contracts and materials contracts, put into
[illegible] separate unit prices, and made clear the economic responsibility; and
in each squad's independent construction, in accordance with the quotas signed
for on the construction assignment book, fixed the assignments for the squad,
[illegible], and individual. In 1979, they thoroughly practiced such methods as
the [illegible] personnel responsibility system, the system of assuming sole
responsibility for profit and loss with regard to funds for wages, and the
[illegible] of making appropriations according to rate of progress, so that the
[illegible] the Fangshan brigade practiced internal accounting. In 1980, they formulated
several kinds of [illegible] construction contingent that would be responsible
for [illegible], production projects and construction. In 1981, they formulated
a [illegible] method for linking wages to output.

[illegible] several years, the Fangshan project has been short of
[illegible] and the "three materials," because the construction unit did not
[illegible] or was [illegible] not resolutely link the initiative to shorten the time
[illegible] of the project, with reducing and strengthening management
[illegible], the "three materials" were realized and fairly good results were
[illegible] in shortening the construction period and improving the investment
[illegible].

[illegible] the Fangshan temporary project is relatively
[illegible]. [illegible] answer is in the affirmative. This
[illegible] the project began, with regard to invest-
[illegible], [illegible] investment basically met demands, there have
[illegible] investment in all the other years. Although in the
[illegible] of these [illegible] they [illegible] adjustment of the investment, frequently
[illegible] and passed, as a result, the "three materials"
[illegible], [illegible] can be guaranteed, to the extent
[illegible] construction--September, October and November--
[illegible] than arrived, that delaying completion of the
[illegible]. [illegible] unit's cadres changed from working on underground
[illegible] to [illegible], and its original construction
[illegible] only 1978 that these pieces of
[illegible] and a complete production line was
[illegible] certain adverse effect on the rate of
[illegible] [illegible] the design of the Fangshan reservoir [illegible],
[illegible] relatively [illegible], and it was simplified

a little the construction could be accelerated. And if the Panjiakou project could be built so as to store water even more ahead of schedule, while construction was done earlier than planned so as to lead the river bend into the irrigation ditches of Tianjin and Tangshan, then the tight situation in water used by agriculture and industry and in water used by municipalities in the Tianjin and Tangshan areas, caused by 2 successive years of drought in North China, would be alleviated, and as a result there would be even bigger benefits from the Panjiakou project.

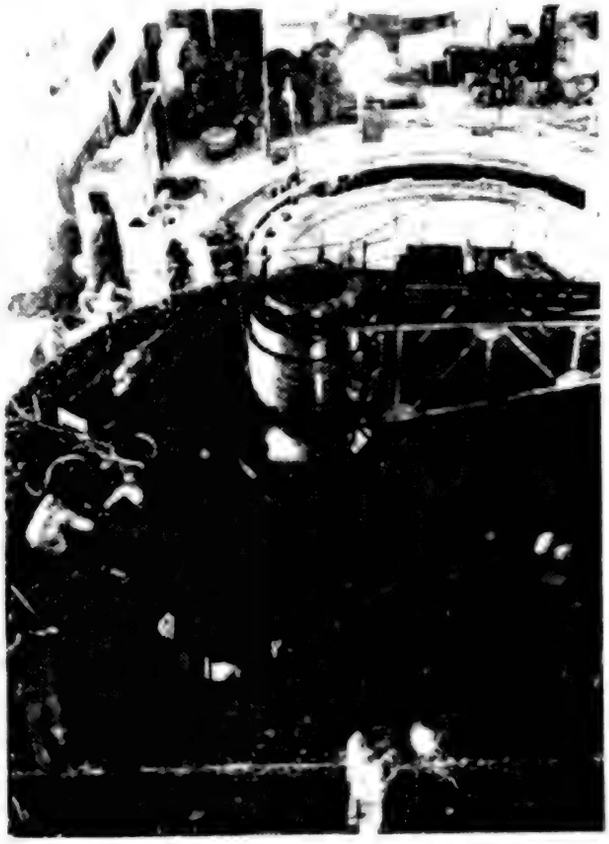
Summing up, this writer thinks that if the principles and policies formulated since the Third Plenary Session of the 11th CCP Central Committee are thoroughly implemented, early-stage work is really done well, construction plans are rationally selected, and full preparations are made for construction, while the building of the ranks and the administration and management are strengthened, and financial capacity and materials are guaranteed, then without a doubt the period for construction of this large water conservancy and hydroelectric project can be shortened and investment results can be improved.

[illegible]
[illegible] zdj/ku

BIG 630,000-KW HYDROPOWER STATION ON THE WU JIANG NEARS COMPLETION

Beijing RENMIN RIBAO in Chinese 20 Aug 82 p 1

[Photograph and caption]



Construction on the Wujiangdu hydroelectric power station--the largest such station on the Wu Jiang--is being stepped up. The station will have an installed capacity of 630,000 KW and a total of three turbines. Turbines 1 and 2 are already generating power.

CSO: [illegible]

STATUS REPORT ON WUJIANGDU, ANKANG HYDROELECTRIC PROJECTS

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 5, 12 May 82 pp 48-49

[Article by special correspondent Zhang Jihua [1728 4949 5478] in the column: "Hydroelectric Power Stations Under Construction"]

[Text] Wujiangdu Hydropower Station

The Wujiangdu hydropower station is located on the mainstream of the Wu Jiang near Zunyi Municipality in Guizhou Province. Its dam is an arch gravity dam with a top-of-dam elevation of 765 meters. The dam is 165 meters at its highest point and the top-of-dam arc length is 368 meters. The total volume its reservoir is 2.3 billion cubic meters. The spillway pattern [illegible] dam spillway (13 x 19) meters and 6 openings, to [illegible] middle-opening sluiceway (4 x 4 meters and 2 openings, elevation [illegible] bottom slab 680 meters), flood discharge tunnel [illegible] is a pressure-free tunnel, with a section of 9 x 10 [illegible] s and [illegible] slab elevation of 720 meters), and also on the ri[illegible] ank is a [illegible] (3 x 7 meters, height of entry base 680 meters). The power sta[illegible], of the riverbed type behind the dam, is equipped with thr[illegible] ing units, so that the total generating capacity of the units is 630,000 kw and the annual amount of electricity generat[illegible].

The Wujiangdu Power Station was designed by the Central South Survey and Academy of the Ministry of Electric Power Industry, and the No 8 Hydropower Engineering Bureau of the ministry was made responsible for its construc[illegible]

work began on the Wujiangdu Power Station in 1970. Because the criteria the diversion tunnel was lowered, because of geological reasons, and because a large amount of supplementary exploration had to be done to perfect the design, the time limit for the project was set back by 2 years. By the end of 1981, 2,745,000 cubic meters of earth and stone had been excavated, 99.8 percent of the designed total; 2,468,700 cubic meters of concrete for the dam had been poured, 99.8 percent of the designed total; and the dam has been given 2,023,000 meters of heavy grout, 96.4 percent of the designed total. The rate of construction has been fairly fast and its quality fairly [illegible] The No 1 generating unit began to generate electricity in 1979, and the 2 generating unit went into operation in 1981. Now the final part of the project is being done and the No 3 generating unit is being installed.

[illegible] the Wujiangdu hydropower station is located in a karst area, because [illegible] of the dam site is narrow, and because the riverbanks are [illegible] precipitous, the construction was fairly difficult. When dealing [illegible] the tunnels and the station building and the dam, the staff and workers [illegible] Hydropower Engineering Bureau were conscientious and careful, [illegible] hard and fighting manners, and completely met the design requirements. [illegible] the concrete for the principal part of the project, a 20-ton cable crane [illegible] was let down the buckets of concrete.

[illegible] qualification rate was 100 percent, and an inspection showed that everything was [illegible] standard, more than 80 percent was rated as excellent. The [illegible] of cement was on average 0.15, the high-pressure heavy grout [illegible] standard requirements, and the unit water absorption rate was in general [illegible] than 0.001 liters per minute. The generating units and electrical [illegible] installations are all up to standard, and the proportion that are of excellent [illegible] standard is 85 percent. During the construction of the project, in order [illegible] solve the problem of a shortage in the area of natural sand and rock, the [illegible] built an artificial sand and rock system, which can produce annually [illegible] 1 million cubic meters of artificial sand and rock (the unit cost of artificial [illegible] and rock is 7.40 yuan per cubic meter). In order to conserve the "three [illegible] materials," [illegible] the use of steel formwork and prefabricated concrete formwork [illegible] used. [illegible] and making the concrete, large amounts of additives were [illegible] used, so that [illegible] cubic meter of concrete 195 kg of cement were used. [illegible] order to satisfy the requirement for high-pressure grout, the workers [illegible] successfully trial-manufactured a grouting machine with a pressure of [illegible] 70 kg per square centimeter, and solved the difficult technical problem in a [illegible] [illegible] of the sand not being rinsed and packed down.

[illegible] the Wujiangdu hydropower station, valuable experiences were [illegible] in [illegible] building a high dam in a karst area and building [illegible] on the mountain.

[illegible] Hydropower Station

[illegible] Liuma Xia, should read [illegible] in Shuicheng County, Guizhou Province. This power station is mainly [illegible] [illegible], but it [illegible] multipurpose benefits for navigation, [illegible] and irrigation. The power station [illegible] formed by a concrete [illegible], straddling [illegible] the river, an electricity-generating station [illegible] on the [illegible] bank, and a [illegible]. The hub's normal high water point [illegible] 1,130 meters [illegible], is [illegible] 120 meters of its maximum height, its [illegible] [illegible] 1 billion cubic meters, and it can be regulated [illegible]. Installed in the power station are four [illegible], so that their total capacity is 800,000 kW. [illegible] guaranteed output [illegible] kW, and the amount of electricity generated [illegible]. The project was designed by the Northwest Survey [illegible], Design and Hydropower Engineering Bureau was made [illegible]

[illegible] water is a broken-line gravity
[illegible] meters, a maximum dam height of
[illegible] meters, and a crest-dam length of 131.5 meters. The dam was constructed
in 28 sections. The [illegible] structure includes 7 external openings (each
[illegible] meters in width), 6 middle openings (each 11 meters
in width and [illegible] meters in height), and 1 bottom opening, which are separately
arranged [illegible] on the left side of the middle of the riverbed. The
structure contains the [illegible]-type trashrack. The electricity generating build-
ing [illegible] of the river behind the dam.

[illegible] the [illegible] high tailwater, the buildings
[illegible] trees. The maximum height of the
[illegible] building have a total
[illegible] structure consists of a
[illegible] dam section in a diversion channel
[illegible], a set of tun gate [illegible], and reinforced concrete
[illegible] the right and left [illegible] the maximum size for a vessel
[illegible].

[illegible] Hydropower Station were: excavating and
[illegible] meters of earth and rock, of which the amount used
for the principal part of the project was 4.3 million cubic meters;
[illegible] million cubic meters of concrete, of which the amount used for the principal
part of the project was [illegible] million cubic meters; installing of 21,000 tons of
metal structure, of which the amount used for the principal part of the project
was [illegible],000 tons; [illegible],000 meters of foundation grout and drainage structure;
[illegible],000 meters of grout for pressing in the seams.

[illegible] Hydropower Station project were: the time
[illegible], construction was difficult and highly
[illegible]. The [illegible] work period included effecting communication with
the outside, [illegible] diversion project, installing the cable machines,
[illegible] enterprises. It required [illegible] million cubic
meters of earth and rock, 960,000 cubic meters of concrete,
[illegible] structures. Most of this had to be completed before
[illegible], [illegible] conditions would be created for large-scale
[illegible] the financial gain of the project. The difficulty in constru-
[illegible] foundation was a complex matter;
[illegible] were used for the underwater foundation
[illegible] spillway surface (including a 650,000-cubic-
[illegible], and one discharge flow rate is 200,000 cubic
[illegible] meters per second. The layout was
[illegible], the [illegible] were complex and the structural construction tasks
[illegible]. The construction was highly intensive:
[illegible]
[illegible]
[illegible]

[illegible], there are small floods, the river rise and fall are [illegible], the [illegible] water flows through the base tunnel. All [illegible] construction can only be done for half of every year. Therefore, [illegible] difficulties accompanied the construction, and as a result [illegible] of construction reorganization was required for the [illegible] project.

[illegible] preparations in 1975 and 1976, preparatory construction of the [illegible] Hydropower Station project began at the end of 1976. At present, [illegible] arrangements for construction have taken on a definite scope: the [illegible] highway to the outside has been completed and is open to traffic, [illegible] special railway line is expected to be completed by the end of 1982; [illegible] first stage of the sand and rock quarry project has been completed and [illegible] now being put on the second stage, and after the quarry project is [illegible] the daily output will be 12,000 cubic meters of earth and rock. [illegible] concrete mixing plant (production capacity of 360 cubic meters per hour) [illegible] similar built. Already completed at the dam site are the diversion project, [illegible] headrace project with cable machines (four 20-ton parallel machines), [illegible] guided flow spillway tunnel on the right bank of the river for the [illegible] project, the earth and stone cofferdam on the left bank of the [illegible] permanent [illegible] water, the small arch cofferdam for clear channel [illegible], as well as the large cofferdam with the large diversion wall and sunken [illegible] and the large diversion earth and stone cofferdam. Concrete has already been poured to the designed height for the large diversion wall and sunken [illegible], and in 1982 the concrete will begin to be poured for the [illegible] and the first of the diversion channel on the left bank. It is [illegible] that the [illegible] station project will begin to store water in 1985.

[illegible] DIVERT ON TAIPINGWAN, XINBUTAN HYDROELECTRIC PROJECTS

[illegible] HUILI XIAOXIAN [XAVIER TOWER] in Chinese No 6, 12 Jun 84 p 33

[Article by special correspondent Zhang Jinan [1728 4930 5478] in the column: "Hydroelectric Power Stations Under Construction"]

[Text] Taipingwan hydroelectric power station

The Taipingwan Hydroelectric Power Station is located on the Hun Jiang, a branch of the Yalu Jiang, in Kuandian County, Liaoning Province. It is 90 kilometers from the Huilongshan Hydroelectric Power Station in the upper reaches and 87 kilometers from the Huanren Hydroelectric Power Station. The power station has been developed as a mixed type mainly to generate electricity but it also serves irrigation and fish culture. The total capacity of the four generators installed is 191,000 kilowatts. The average output of electricity over many years is 630 million kwh. The project was designed by the Northeast surveying and design institute and constructed by the Sixth Engineering Bureau.

The [illegible] of the hydroelectric power station includes a concrete gravity dam, an auxiliary dam, a diversion tunnel, pressure channels and a power plant. The dam has a maximum height of 44.2 meters, the normal high water level is [illegible] meters, the corresponding reservoir capacity is 164 million cubic meters, and the full length of the top of the dam is 557 meters. On the left and right sides are concrete dike segments. A spillway dam is in the river bed at the center. There is a total of 21 dam segments with 20 holes (the width of the hole is 13 meters), the height of the top of the weir is 181.5 meters. There is an arc shaped working floodgate of 12 x 10.5 meters and two diversion tunnels. The portions are square and round in shape (10 x 10.2 meters). The total length is 1,[illegible] meters. There are four steel pressure tubes, each having a diameter of 5 meters and a length of 310 meters. The power station construction is of the diversion surface type. The total construction of the power station [illegible] excavating 1,720,000 cubic meters of soil and rock. Construction of the tunnel included excavation [illegible],700 cubic meters. The amount [illegible] 49,000 cubic meters.

[illegible] of the Taipingwan [illegible] station, [illegible] are regulation and [illegible], most of the diversion [illegible] construction and [illegible] drilling and blasting. [illegible] surface blasting [illegible] drilling and blasting constitute 71.4 percent. Slag bed [illegible]

- 44 -

...water used in the concrete structures of the floor of the diversion ... The construction of the shell of the plant housing used "T" shaped ...lined protective type steel plates to prevent leakage. In the concrete ...structure of the large dam, cement expanded pearlite temperature-preserving ...were used, etc., and much experience in construction was accumulated ...these aspects.

The main construction project of the Laipingshao Hydroelectric Power Station began on 25 October 1976. The first generator began generating electricity at the end of 1979. Construction lasted for 3 years. Immediately following this phase was the completion of installing the remaining three generators in 1980. The rate of construction of the power station was relatively fast. Now, the water level in front of the dam of the power station has reached 191. meters. The hydro-engineering structures and the generators are operating well. By the end of 1981, the station had already generated ...million kilowatt-hours of electricity. The project is now basically completed. It is estimated that it can be officially delivered to the authorities within the near future.

...ongguan Hydroelectric Power Station

The Longguan Hydroelectric Power Station is located on the Longguan Xi, a ...in the upper reaches of the Ou Jiang in Yunhe County, ...Province. Its main purpose is to generate electricity and but it also ...flood prevention, navigation and the passage of logs. The area of the ...basin controlled by the power station covers 2,761 square kilometers, ...constituting ...percent of the total area of the entire river valley of the ...dam. The normal water level of the reservoir is 184.0 meters and the ...corresponding storage capacity is 104 million cubic meters. It is a seasonal ...storage reservoir. The installed capacity of the power station is ...kilowatts (four 50,000-kilowatt generators), the guaranteed output is ...kilowatts, and the annual output of electricity is about 500 million ...kilowatt-hours. The power station was designed by the East China Survey and ...Design Institute and constructed by the 7th Engineering Bureau.

...of the power station includes the concrete double-curvature arch dam, ...power plant on the right bank at the toe of the dam, and facilities for ...passage of logs. The height of the top of the large dam is ...meters, the maximum height of the dam is 99 meters, the width of the ...top, the bottom thickness of the dam is 22 meters and the arc ...length of the top is 130.5 meters. The method of flood discharge ...is by the open surface outlet at the top of the dam and flood ...discharge through the six channels of the central holes on the two sides. ...The central holes are located very close to the two sides of the ...river banks. The right bank entrance of the central holes has a height ...of 21 meters, is 7 meters tall and 7.5 meters wide. The ...power plant is located behind the dam. Four of the four ...penstocks have a diameter of 4.6 meters. The construction of the ...earth and rock dam involved pounding 780,000 cubic meters of ...soil and rock, excavating 19,000 cubic meters, 665,000 cubic ...meters of concrete poured, and the metallic structures installed total ...tons of steel.

The construction unit has begun preparations for construction in 1980. The access road to the construction site has already been opened to traffic. The bridge at the lower reaches of the dam site area has already been built. Preparations for construction begun in 1981 have prepared the conditions for building the projects to guide the flow in 1982. At present, the top guiding tunnel of the project to build flow-leading tunnels has been tunneled through. The 110-kilovolt step-down station on the site has already begun production. The supply systems for air, water and electricity have already been formed. The system for excavating and screening sand and rocks and the system for mixing concrete are being constructed intensively. The excavation of the platform for the cable crane is being carried out. At the end of 1981, 64,100 square meters of power house space were built (area of construction completed). At the same time, the living area and a rear production base have been build in Jinhua Prefecture. The power station is scheduled to intercept the flow in 1983 and the first generator will be installed and will begin generating electricity in 1986.

CSO
80: 4013/106

ECONOMIC EFFICIENCY OF SMALL-SCALE HYDROPOWER IN SHANTOU PREFECTURE ANALYZED

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 3, 25 Jun 82 pp 41-43

[Article by Chen Haojiu [7115 7729 0036]: "Analysis of the Economic Benefits of Small Hydroelectric Power Stations in Shantou Prefecture"]

[Text] Shantou Prefecture is situated along the coast in eastern Guangdong Province. The average amount of rainfall over many years is 1,882 centimeters. Hydraulic power resources are relatively abundant. Because it lacks coal and oil and it is far away from the large power network, the electric power industry is very weak. Industrial and agricultural development has been affected. To solve the insufficient supply of electricity, the development of small hydroelectric power began in 1958. By the end of 1980, the whole prefecture had already built and begun operating 1,208 medium and small hydroelectric power stations with a total installed capacity of 167,700 kilowatts, generating 450 million kilowatt-hours of electricity annually. Among them, 1,206 are small hydroelectric power stations with an installed capacity of 129,000 kilowatts (constituting 77 percent of the total installed capacity of hydroelectric power) and generating 270 million kilowatt-hours of electricity annually. There are two medium power stations with installed capacity of 38,640 kilowatts.

1. Analysis of the Economic Benefits of Small Hydroelectric Power Stations

The purpose of analyzing the economic benefits of small hydroelectric power stations is to prove the economic rationality and the reliability of operation of the small hydroelectric power stations so that the projects can produce maximum results with minimum cost.

The content of an analysis of the economic benefits of small hydroelectric power stations includes: building cost of the power station, length of the construction period, material consumption, cost of electricity, amount of output of electricity, the quality of electricity (voltage, cycle and guaranteed percentage) and the social benefits from using electricity. Only by analyzing the direct economic benefits and the social benefits of small hydroelectric power stations can we appropriately evaluate the economic benefits of small hydroelectric power stations.

(1) Analysis of the construction cost of small hydroelectric power projects

The investment in construction of small hydroelectric power stations in Shantou, based on the source of capital, can be divided into state investment, local funds and commune and brigade funds. From 1958 to 1980, the investment in small hydroelectric power stations throughout the prefecture was about 163 million yuan. Of this, state investment was 36,640,000 yuan, constituting 22.48 percent of total investment. The rest was funded by the prefecture, the counties, communes and brigades. This shows that most of the investment for building small hydroelectric power stations in Shantou Prefecture relied on local funds.

Because a fairly large portion of the water conservancy and hydroelectric power projects was comprehensive utilization projects of "using one water source for many purposes," therefore, investment in the projects must be rationally shared by the departments receiving the benefits according to the principle of sharing the investment in proportion to how much benefits one receives. Sharing of the investment in small hydroelectric power stations in Shantou follows the following methods:

The investment in capital construction of hydroelectric power stations built on already existing water conservancy facilities (such as reservoirs, canals) includes only the cost of building the hydroelectric power stations themselves.

The investment in civil engineering projects such as reservoirs built to generate electricity is borne entirely by the hydroelectric power station and is included in the construction cost of the hydroelectric power station.

Civil engineering projects such as reservoirs that have many benefits such as flood prevention, irrigation and power generation are invested by whoever builds them and whoever administers them. The reservoirs and power stations engage in commercial exchange to purchase water and electricity. This method is easy to manage and accounting is unified and convenient, and it is easier to carry out.

The analysis of investment in small hydroelectric power stations is as follows:

1. Analysis of the scale of the power station. The average investment per kilowatt in the 911 small hydroelectric power stations that constitute 94.78 percent of the total installed capacity of hydroelectric power throughout the prefecture is 986 yuan, and the investment per kilowatt-hour of electricity is 0.311 yuan. Among them, 10 stations (37,000 kilowatts) utilize existing reservoirs and conditions to build small hydroelectric power stations with comprehensive benefits. The average investment per kilowatt is 803 yuan, and investment per kilowatt-hour of electricity is 0.163 yuan. Seventeen stations (34,000 kilowatts) are small hydroelectric power stations that mainly generate electricity. Because the investment includes a larger proportion of the cost of construction [illegible]

construction. According to incomplete statistics, small hydroelectric power stations built between 1976 and 1980 had an average investment of 1,[illegible] yuan per kilowatt and the investment per kilowatt-hour of electricity was [illegible], a rise of 48.64 percent and 65.68 percent over those built between 1971 and 1975, respectively. The percentages of power stations with [illegible] kilowatts and above rose 90.4 percent and 144.1 percent respectively, and the percentages of small hydroelectric power stations with [illegible] kilowatts or below for farm villages rose about [illegible] percent.

[illegible] unit kilowatt investment, the average level of the small hydroelectric [illegible] stations in Shantou Prefecture is lower than the average values of some [illegible] provinces and municipalities. For example, it is 185.81 yuan lower than the average [illegible],[illegible] yuan per kilowatt for the nation's hydroelectric power stations built between 1950 and 1979.

[illegible] Consumption of Building Materials

[illegible] small hydroelectric power stations in Shantou was [illegible] and [illegible] took 5 years. For example, the Baishanxi Power [illegible] installed capacity of 2,160 kilowatts. Including [illegible] reservoir with a reservoir capacity of [illegible], the entire project was completed in a year and 5 months. [illegible] consumption of materials per kilowatt for the small hydroelectric power stations in the [illegible] Prefecture was: 0.0696 tons of steel, 0.[illegible] tons of wood. Among the various types of power [illegible] in building power stations that utilized [illegible] expenditures was the lowest. The average [illegible] kilowatt was [illegible] tons of steel, 0.[illegible] tons of wood.

[illegible] Small Hydroelectric Power Stations

[illegible] is an important measure [illegible] the performance [illegible] small hydroelectric power stations. The [illegible] small hydroelectric power [illegible] that constitute [illegible] period [illegible] small hydroelectric power stations increased [illegible] the three years [illegible] 1978 to 1980 [illegible] amounts of water. The corresponding

[illegible] of utilization of the facilities was 16.1% percent. Among them, the average number of hours of use of the power stations that combined irrigation with the generation of electricity was 1,942 hours, and the percentage of utilization of the facilities was 22.1 percent. The percentage of use of the hydroelectric power stations in farm villages was only 14.7 percent. The annual average number of hours of use of hydroelectric power throughout the prefectures during the 11 years from 1978 to 1988 was 3,034 hours. The highest was 5,111 hours realized by the Lianxiang Third Step Power Station in 1979.

[illegible] Annual Operating Cost and Cost of Electricity

When considering the value of a power station, besides its investment, we must look at its annual operating cost and cost of electricity. The annual operating cost of a small hydroelectric power station mainly includes the indirect operating cost which includes depreciation of equipment and major repairs and the direct operating cost which includes the cost of generating electricity, annual maintenance cost, management costs, transportation and other costs. According to incomplete statistics, the unit cost of electricity of the small hydroelectric power stations of single generators of 100 kilowatts and more throughout the region averaged [illegible] fen/kilowatt-hour of electricity during the three years of operation from [illegible] to 1988 (see table). The annual operating cost per kilowatt of installed capacity was 42.58 yuan. Based on the nature of the expenditure in the annual operating cost, production type expenditures constituted 70.4 percent and non-production type expenditures constituted 29.6 percent. In production type expenditures, depreciation and major repair costs constituted 36.1% percent of the total annual operating cost, and the cost for water to generate electricity [illegible] 21.87 percent. Non-production type expenditures of mini hydroelectric power stations in farm villages (with single generators of less than 100 kilowatts of power) constituted 11.6 percent. This showed that the level of management could not catch up. Analysis of the annual operating cost and [illegible] of the 46 small hydroelectric power stations showed that the small hydroelectric power stations with the lowest cost per unit of electricity throughout the prefecture were: Baishasi, Renxiang and Banchang Third Step Power Stations, all 2.1 fen/kilowatt-hour and that of the rest [illegible] kilowatt-hour. Calculating at a price of electricity of [illegible] yuan per kilowatt-hour, an average profit of 8 fen could be realized per kilowatt-hour of electricity.

[illegible] Number of Years for a Return on Investment

[illegible] the number of years for a return on investment in a small hydroelectric power station, generally the more economical power stations [illegible] the number of years for a return on investment [illegible] power stations in Baishui Prefecture [illegible] number of years of the backbone power stations [illegible] kilowatts of power and above was [illegible]

[illegible] Operation Cost and Cost of Electricity of Small Hydroelectric Power [illegible] in Qiantou Prefecture

	Unit
[illegible] results	
Cost of electricity	yuan/kilowatt-hour
[illegible] station cost per kilowatt	yuan/kilowatt
Average of 2-year operating cost	
Installed capacity statistics	kilowatt
Original 1-year operating cost	10,000 yuan
Future 1-year operating cost	10,000 yuan/year
[illegible]	
depreciation	10,000 yuan
Major repairs	10,000 yuan
Cost of water to generate electricity	10,000 yuan
Annual maintenance cost	10,000 yuan
Wages and retirement fees	10,000 yuan
Administration	10,000 yuan
Transportation and others	10,000 yuan
Average electricity output over 4 years	10,000 kilowatt-hour

[illegible] [illegible] years [illegible]

[illegible] Hydroelectric Power Stations

	Diesel generator of [illegible] per kilowatts	Small hydropower in farm villages
[illegible]	0.017	0.047
[illegible]	91.32	133.95
[illegible]	[illegible]	[illegible]
[illegible]	1,426.74	486.77
[illegible]	423.38	181.92
[illegible]	[illegible]	46.15
[illegible]	[illegible]	16.92
[illegible]	[illegible]	31.13
[illegible]	[illegible]	2.6
[illegible]	[illegible]	14.18
[illegible]	[illegible]	21.62
[illegible]	[illegible]	7.79
[illegible]	[illegible]	0.0

[illegible] OF SMALL-SCALE HYDROPOWER IN QIANGZI COUNTY, [illegible]GIAN PROVINCE

by [illegible] SIJAO in Chinese 21 Jan 81 p 2

[illegible] As a result of a carefully planned program of water utilization, [illegible] counties, Zhejiang Province has been able to achieve continuous [illegible] from small-scale hydropower stations in the mountain regions. [illegible] has the necessary energy resources for [illegible] of the area's [illegible] power.

In recent years, Qiangzi County has initiated a program to systematically [illegible] the water resources of all the rivers in the county. By building [illegible] water reservoirs on terraced terrains, they were able to combine water [illegible] conservation with power generation, flood prevention, and protection against drought. The 48-km long Qingqi River originally had only the Xiayang power station with a capacity of 3,200 kilowatts; during the dry season its output [illegible] reduced to only one-third of the designed capacity. During the past [illegible] years, funds were made available to build a 38-million cubic meter reservoir [illegible] in the large upstream; the reservoir not only provides protection against drought and [illegible], but also serves as a fish pond and supplies water for power generation, [illegible] of the Xiayang power station now operates continuously. Two additional [illegible] stations with capacities 2,200 kw and 2,400 kw respectively were constructed downstream, thereby doubling the power output of the river. In the [illegible] Brigade of Zhima Commune, a small 250-kw power station existed [illegible] upstream of the Yenyang River. After the recent completion of a water [illegible] reservoir in the Tuantou Mountain, two more power stations were added, [illegible] increasing the total power output to 370 kw, and providing power supply [illegible] all year round. At the present time, approximately half of the [illegible] power stations in the county can operate all year around and provide balanced [illegible] power supply.

[illegible] construction of water reservoirs for power generation significantly enhances [illegible] development of small-scale hydropower; the total capacity of hydropower [illegible] in the county has reached 12,000 kw, which is double the capacity [illegible], and the total power output has increased 2.5 times. [illegible] percent of the production teams now have electricity. [illegible] activities demanding large power consumption such as [illegible], [illegible], and power [illegible] cannot operate normally [illegible] without a rubber. With the availability of electricity, [illegible] operations such as wood processing, wood processing, grinding [illegible], construction and tea-making have been mechanized.

[illegible]

[illegible]: A SMALL SCALE CASCADE HYDROPOWER PROJECT

[illegible] [WATER CONSERVATION AND HYDROELECTRIC POWER] in Chinese No 6, 20 Jun 82 pp 54-55

[Article by Gan Shangzhou [3927 4800 2052] of the Hydroelectricity Bureau of [illegible] County, Hunan Province: "Planning and Design of the [illegible] Cascade Power Stations and the Regulatory Reservoir"]

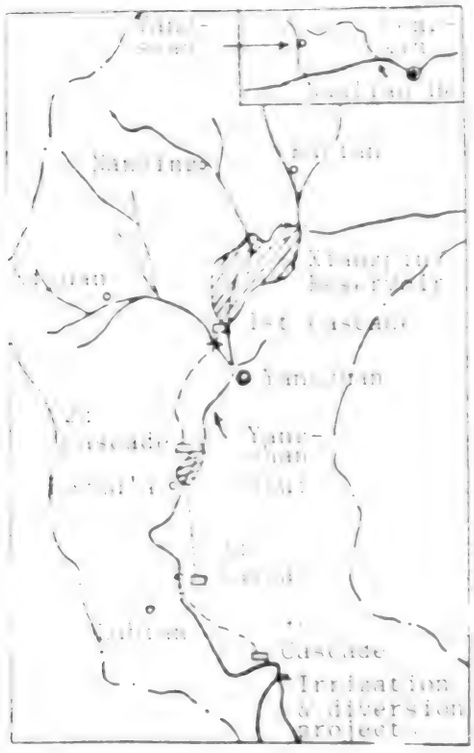
[illegible]

[illegible] branch of the Nanliao He. A small river valley [illegible], its area is 84 square kilometers. Topographically, [illegible] mountains at the upper reaches suitable for building [illegible]. The fall at the middle and lower reaches is large [illegible] to develop. After comparing many plans, a plan for a four-[illegible] development [illegible] (see following map). The first cascade power [illegible] reservoir that controls an area of [illegible] kilometers of the river valley. The remaining three cascades are [illegible] the power stations. The gross waterhead reaches 356 meters and [illegible] have a total installed capacity of 7,500 kilowatts. [illegible] are listed in the following table. After the power [illegible] are completed, they will join our county's small independent hydro-[illegible] network (it now consisting of the Laoyigong Power Station with an [illegible] kilowatts and some other runoff power stations).

[illegible] how to improve the guaranteed output of the system [illegible] the emphasis [illegible] the plans and design of the regulatory [illegible] of the Laoyigong Power Station.

[illegible] Necessity of Building a Regulatory Reservoir

[illegible] runoff during the year is very uneven, the differ[illegible] in the amount of flow in the flooding and the dry season is very large. Take the Laoyigong Power Station site as an example: the runoff in the flooding [illegible] (April to July) accounts for 61.1 percent of the annual runoff, and the [illegible] for the dry season (August to March) constitutes 38.9 percent, with a



location of the Yangshan Shui River Valley and the distribution of its cascade power stations

Table 1: Dynamic Indices of the Yangshan Shui Cascade Power Stations, Fenxin County

Cascade	Head (meters)	Guaranteed flow (m^3/sec)	Guaranteed output (kw)	Annual electricity (10,000 kwh)	No. of hrs. utilization a year (hrs.)	Installed capacity (kw)
1. Xiaojiang	12.5	1.40	345	181.5	5,280	400
2. Liangjiang	10.4	1.80	382	264.0	6,900	500
3. Yangshan	20.2	1.65	2,260	1,987.0	8,800	4,000
4. Jiangkou	14.8	1.70	1,802	1,434.0	7,960	2,500
Total	161.7		4,789	3,866.5	18,770	7,300

ment in June, and the lowest runoff in December,

MINI-HYDROPOWER STATIONS POINTED OUT

[redacted] in Chinese No 4, 5 Apr 82 p 44

[redacted]: "Mini-Hydropower Stations in [redacted]"

[redacted] is often in mountain areas, especially in remote mountain [redacted], people [redacted] far from power networks, their houses are dispersed, and communication is inconvenient. An effective method providing the masses [redacted] is to fully utilize local scattered sources of water power [redacted] electricity-generating units. The [redacted] mini-hydropower stations in Fengxin County shows their [redacted]. [redacted], [redacted] mini-hydropower stations in Fengxin County [redacted] with a total installed capacity of 487 kw. In Luotang Commune [redacted], there are 19, with a total installed capacity of 178.5 kw; [redacted] (but 187 sq km of drainage area), [redacted] of water, and they have a total capacity of [redacted] at present. This article will only [redacted] on the use of mini-generating units in Fengxin [redacted] to them.

[redacted]

[redacted] the following three points of [redacted] stations.

[redacted] scattered sources of water power. [redacted] in the remote mountain areas of our [redacted] head areas. Forests are [redacted], of many years being an annual output of [redacted] water permits the runoff is relatively [redacted] down very steeply, and it is extremely [redacted]. [redacted] are far from power network [redacted] in old mountain areas, the lines would be too [redacted] would also be extremely scattered, and [redacted] small (small-sized) power generating units

Table 1. Brief Data of Three Mini-hydropower Stations in Fengshun County

Power Station Name	Head (meters)	Flow rate (cubic meters per second)	Hydraulic turbine Model	Auxiliary Generator	Use of generated electricity
Baoli	11.8	0.167	HL240-LJ-20	TSW30.8-12-56	Motive power for processing agricultural and subsidiary products; lighting for units subordinate to the production brigade and three production teams (75 households); electricity for radios in the 11 production teams of the production brigade.
Xiabao	16	0.027	XJ13-L-15/4.5	JO_2-41-6 3 kw	Motive power for processing agricultural and subsidiary products and lighting for 3 natural villages (32 households).
Lejia	10.5	0.0775	HL240-LJ-14	JO_2-32-4 3 kw	Motive power for processing agricultural and subsidiary products and for sawing boards, and lighting for 3 natural villages (28 households).
Dujiabian	12	0.0108	XJ13-L-10/3	JO_2-12-4 0.8 kw	Lighting for 7 households.

(Article revised by editorial department of XIN NENG YUAN)

SMALL-SCALE POWER STATIONS PROLIFERATE

Shanghai DIANSHIJIE [ELECTRICAL WORLD] in Chinese No 3, Mar 82 p 29

[Text] Over 1,600 Additional Small Hydroelectric Stations Built

From January to September 1981, the nation built over 1,600 additional small hydroelectric power stations, increasing the installed capacity by 400,000 kilowatts. Thus, the nation's farm villages now have over 90,000 small hydroelectric power stations with a total installed capacity of 7,330,000 kilowatts. Between January and September 1981, small hydroelectric power stations generated 8.3 billion kwh of electricity. Small hydroelectric power stations have become an important energy source in the farm villages in our nation.

Guangdong Small-Scale Hydroelectric Stations

Up to August 1981, Guangdong Province has completed building 14,000 small hydroelectric power stations with an installed capacity of over 1.08 million kilowatts, constituting 15 percent of the total installed capacity of small hydroelectric power stations throughout the nation and leading all other provinces and regions. Between January and August 1981, the total output of electricity of the whole province's small hydroelectric power stations was over 1.3 billion kwh, constituting 17.5 percent of the total output of electricity throughout the province. They have become an important part of the whole province's power industry.

Communes in Fujian Jointly Operate Small Hydroelectric Station

Twelve communes in Yongan County jointly operate the Yamutan Hydroelectric Power Station. It is the largest commune-run power station in Fujian Province. In the first stage of construction, two generators were installed and joined the power network to generate electricity. After the whole power station is completed, total capacity will be 10,000 kilowatts, and it will irrigate 18,000 mu of farmland. Each year, it can realize a net profit of more than 2 million yuan. All investment will be recovered in 5 years. Its total length is 224 meters.

... Hydropower in Hebei

... County utilized water conservancy resources in the mountain regions and built 134 small hydroelectric power stations with a total installed capacity of 7,800 kilowatts.

... Power Station Is More Than 100 Meters Underground

Zhijian County has built a 250-kilowatt hydroelectric power station in an underground cavern. It has opened a new way to develop and utilize underground hydraulic resources. This hydroelectric power station in an underground cavern is more than 100 meters below ground surface.

9296
CSO: 4013/130

SELECTION OF MAIN TRANSFORMERS FOR SMALL-SCALE RURAL HYDROPOWER STATIONS

Beijing SHUILI SHUIDIAN JISHU [WATER CONSERVATION AND HYDROELECTRIC POWER TECHNOLOGY] in Chinese No 5, 20 May 82 pp 50-51

[Article by Qing Yongkang [7230 3057 1660] of the Hydroelectric Power Bureau of Mianzhu County, Sichuan Province: "Economic Selection of the Main Transformer for Hydroelectric Power Stations in Farm Villages"]

[Text] When designing the main transformer of small hydroelectric power stations in farm villages (including main transformers for other agricultural substations), the determination of the main electrical connections is a very important aspect. The main problem is how to correctly select the number and the capacity of transformers. When determining the main connection, we must make sure that the main transformer can satisfy the technical requirements of the main connection and we must also reduce the loss of electricity to reduce the annual operating cost so that investment can be conserved. We now analyze the economic selection of transformers by studying the efficiency curve and the load-loss characteristic curve of the transformer.

I. The Most Economical Load of a Transformer

Diagram 1 shows the efficiency curve of the transformer and the relationship between the efficiency η and the load β of the transformer. β is the ratio of the actual load S of the transformer and the specified capacity S_n. It can be seen from this curve that when the load of the transformer begins to increase from zero, the efficiency begins to rise rapidly until it reaches a maximum value, then it begins to drop. This is because the power loss of the transformer has a term for iron loss that does not vary with the load. It is related only to the capacity and voltage of the transformer, and it keeps the efficiency low under small loads, while copper loss is directly proportional to the square of the load. As the load increases, copper loss increases rapidly and the efficiency drops again.

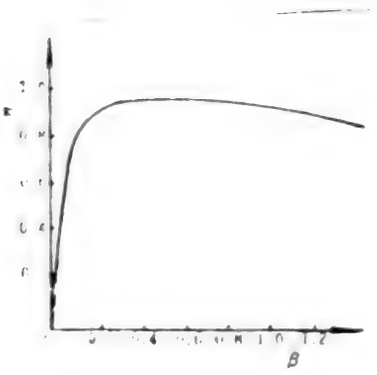


Figure 1. $n = f(\beta)$ curve

The load at maximum efficiency can be obtained by differentiation. Let: ΔP_0 be the iron loss, i.e., the no-load work loss of the transformer under specified line voltage U_n in kilowatt units; ΔP_{kn} is the copper loss, i.e., the work loss of the transformer under the specified capacity S_n in kilowatt units; $\cos \psi_2$ is the power factor, thus the efficiency formula is

$$\eta = 1 - \frac{\Delta P_0 + \beta^2 \Delta P_{kn}}{\beta S_n \cos \psi_2 + \Delta P_0 + \beta^2 \Delta P_{kn}}$$

We solve the above formula for $\frac{d\eta}{d\beta} = 0$, then the load at maximum efficiency is

$$\beta_m = \sqrt{\frac{\Delta P_0}{\Delta P_{kn}}} \quad \text{or} \quad \beta_m^2 \Delta P_{kn} = \Delta P_0 \qquad (1)$$

Equation (1) shows that when the copper loss is equivalent to the iron loss, the efficiency of the transformer is the highest, loss is minimum, and β_m is the most economical load of the transformer.

In the SL_1 series of transformers with a capacity of 100 to 3,200 kilovolt-amperes, $\Delta P_0 / \Delta P_{kn}$ = 1/3 to 1/4; in the SJL_1 series, $\Delta P_0 / \Delta P_{kn}$ = 1/5 to 1/6. Calculations based on the efficiency formula show that the corresponding β_m are 50 percent to 58 percent and 41 percent to 45 percent respectively. We know from the efficiency curve in Diagram 1 that the variation in efficiency is the smallest when the transformer is operating at 50 percent to 100 percent of the specified load. To enable the transformer to operate at the most economical load, the maximum efficiency should be designed at 80 percent of the specified capacity.

II. Selecting the Transformer According to the Load-Loss Characteristic Curve

When n transformers (of the same capacity) are running in parallel, their total loss is

$$\Delta P_s = n\Delta P_0 + \Delta P_{kn}\left(\frac{S}{S_e}\right)^2 \frac{1}{n}. \qquad (2)$$

We will use the Qingping Second Cascade Power Station in our county as an example to explain the selection of the transformer. The Qingping Second Cascade Power Station has three generators. Each has a capacity of 1,250 kilowatts (1,562.5 kilovolt-amperes).

If two SJL_1 -2500/35, 38.5±5% /6.3 kilovolt transformers are used, ΔP_0 =4.25 kilowatts, ΔP_{kn} =27.5 kilowatts. The calculation of loss based on different output of the power station:

For three generators and two transformers (at full capacity),

$$\Delta P_3 = n\cdot\Delta P_0 + \Delta P_{kn}\left(\frac{S}{S_e}\right)^2\frac{1}{n}$$

$$= 2\times 4.25 + 27.5\times\left(\frac{3\times 1562.5}{2500}\right)^2\times\frac{1}{2}$$

= 56.84 kilowatts;

When two generators and two transformers are operating,

$$\Delta P_2 = 2\times 4.25 + 27.5\left(\frac{2\times 1562.5}{2500}\right)^2\frac{1}{2}$$

=29.98 kilowatts;

When one generator and one transformer are operating,

$$\Delta P_1 = 4.25 + 27.5\left(\frac{1562.5}{2500}\right)^2\times 1$$

=14.99 kilowatts.

If we select two SJL_1 -3150/35, 38.5±5% /6.3-kilovolt transformers, ΔP_0 =5 kilowatts, ΔP_{kn} = kilowatts, then we can calculate the loss in the same way: When there are three generators and two transformers, ΔP_3 = 46.[illegible] kilowatts; when two generators and two transformers are operating, ΔP_2 = 26.24 kilowatts; and when one generator and one transformer are operating, ΔP_1 = 13.12 kilowatts.

The load-loss curve drawn from the loss ΔP of different loads of transformers of two different capacities is shown in Figure 2. We know from Figure 2 that using two 3,150 kilovolt-ampere transformers in parallel obviously conserves work loss and no-work loss.

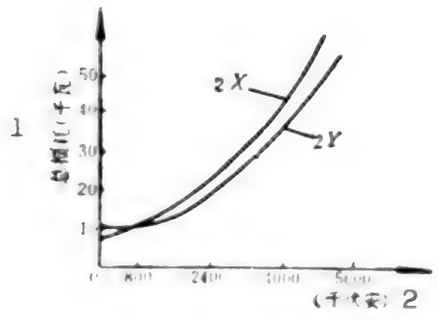


Figure 2. Load-loss curve of transformer

Key:

X --2500 kilovolt-ampere transformer
Y --3150 kilovolt-ampere transformer
1. Total loss (kilowatt)
2. (Kilovolt-ampere)

III. Economic Comparison

We now use the actual cases described above to discuss the economic comparison of transformers with different capacities but bearing the same load. The actually calculated total loss and the annual number of days of operation of the transformers are listed in the following table. We can calculate from the data listed in the table that the use of two 3,150 kilovolt-ampere transformers can conserve the following amount of electricity a year compared to using two 2,500 kilovolt-ampere transformers:

$$A = \{(56.84-46.54)\times 133+(29.98-26.24)\times 97+(14.99-13.12)\times 87\} \times 24$$

$$= 45,500 \text{ kilowatt-hours.}$$

If we calculate at a general price of electricity of 0.05 yuan per kilowatt-hour, we can conserve 2,275 yuan each year. We know from the product catalog that the capacity and price of transformers over 420 kilovolt-amperes are approximately linearly related. We can generally say that for each increase of 1 kilovolt-ampere, the price will increase 8 to 10 yuan. Two 3,150 kilovolt-ampere transformers cost more than two 2,500 kilovolt-ampere transformers by about 10,600 yuan. The increased investment can be recovered from the savings in the cost of electricity in about 5 years.

Loss and Annual Number of Days of Operation of Transformers With Different Capacities Bearing the Same Load

Specified capacity of the transformer (kilovolt-ampere)	Operating condition	Average value of iron loss (kilowatt)	Average value of copper loss (kilowatt)	Total loss (kilowatt)	Annual number of days of operation (day)
2 x 2500	Generation at full capacity	4.25	27.5	50.84	133
	Two operating	4.25	27.5	29.98	97
	One operating	4.25	27.5	14.99	87
2 x 3150	Generation at full capacity	5.0	33.0	46.54	133
	Two operating	5.0	33.0	26.24	97
	One operating	5.0	33.0	13.12	87

Viewing the life of the transformers, we note that when the insulated heat point temperature of ordinary oil-soaked transformers is 95°C, the limit of temperature rise of coal is 65°C, and the useful life is about 20 years. The effects when the insulation temperature is surpassed is cumulative. For each 6 to 8°C rise in temperature, the life of insulation is reduced by half. When using the 2,500 kilovolt-ampere transformer with a load of $\beta = S/S_n = 3x1,562.5/5,000 = 0.94$, the temperature rise of coal is $65x(0.25+0.75x0.94)^{0.8} = 60.2°C$. Similarly, when using the 3,150 kilovolt-ampere transformer under a load of $\beta = 0.74$, the rise in temperature of coal is 46.9°C. Although both increases in temperature do not surpass the limit, the difference is 13.3°C. Thus when we select the 3,150 kilovolt-ampere transformer, we can extend its useful life and a leeway can be left for future development.

According to the above analysis, when designing main connections for small hydroelectric power stations, the use of transformers with a capacity close to the transmission capacity is actually not the most economical. We must calculate the investment and the annual operating cost and compare them comprehensively before we can select the capacity of transformers economically.

9296
CSO: 4013/96

SMALL-SCALE HYDROPOWER PROJECTS ADD 2.48 MILLION KW IN INSTALLED CAPACITY IN THREE YEARS

Beijing RENMIN RIBAO in Chinese 14 Aug 82 p 2

[Article: "An Important Way To Solve the Shortage of Electricity in Our Nation's Farm Villages; During Past Three Years, Nation's Small Hydroelectric Power Stations Added an Installed Capacity of 2.48 Million Kilowatts"]

[Text] During the past three years, the nation's small hydroelectric power stations newly added 2.48 million kilowatts in installed capacity. Up to the end of 1981, the whole nation had 85,000 completed small hydroelectric power stations with installed capacity of 7.57 million kilowatts, constituting one third the total installed capacity of hydroelectric power of the whole nation. In 1981, small hydroelectric power stations generated 14.4 billion kilowatt-hours of electricity, constituting 22 percent of the total amount of electricity generated by hydroelectric power. Among the more than 2,300 counties throughout the nation, more than 740 counties now rely on small hydroelectric power stations for their supply of electricity.

Our nation's resources of small hydroelectricity is abundant and the distribution is wide. There are over 1,000 counties throughout the nation that have exploitable hydroelectric power resources of over 10,000 kilowatts. Fully developing small hydroelectric power is an important measure to solve the shortage of electricity in our nation's farm villages. Since the Third Plenum of the Party, each locality has implemented the policy of "building, managing and using hydroelectric power by itself." The enthusiasm of the locality and the masses to develop electricity has been high. Guangdong province has completed building small hydroelectric power stations with an installed capacity of 1.15 million kilowatts, ranking first in the nation. The installed capacities in Sichuan and Hunan have both reached 800,000 kilowatts. Small hydroelectric power has also developed relatively greatly in Yunan, Guangxi, Xinjiang, Xizang provinces and autonomous regions.

In recent years, each locality readjusted concerned policies according to the actual situation and mobilized the enthusiasm of the localities to develop small hydroelectric power. Some regions established different

prices for electric power according to the supply of electricity during dry seasons and seasons of abundant water, further expanded the use of electricity in farm villages and promoted the development of agricultural and sideline production. After the national power networks in some regions joined the small hydroelectric power system, profits of the national power networks were given to the small hydroelectric power systems according to the policy of recovering costs without making profits. This was favorable to increasing the economic benefits of small hydroelectric power and improving the quality of electricity.

Since the beginning of this year, many provinces and autonomous regions took the development of small hydroelectric power as an important measure to conserve energy, to increase the sources of energy and to protect mountains and forests. Zhejiang, Guangxi, Sichuan, Jiangxi provinces and autonomous regions utilized the electricity generated during the season of abundant water in regions where small hydroelectric power is more developed as a substitute for firewood to develop electrical heating to manufacture tea, to cure tobacco, to cook rice, etc. The results were visible. Xinchang County in Zhejiang province tested the use of electrical heat to manufacture tea at 135 production brigades and conserved over 10,000 tons of firewood.

Qingying Hydroelectric Power Station built and operated by the Tianjing Commune at the foot of Emeishan in Sichuan. It was built in a year and 3 months with an installed capacity of 600 kilowatts and an investment of 570,000 yuan. After it began production in 1979, its annual income was 130,000 yuan. The gain was outstanding.

9296
CSO: 4013/149

[illegible] WLR

NEW SERIES OF GENERATORS FOR SMALL-SCALE HYDROPOWER STATIONS NEEDED

Beijing SHUILI SHUIDIAN JISHU [WATER CONSERVATION AND HYDROELECTRIC POWER TECHNOLOGY] in Chinese No 6, 20 Jun 82 p 64

[Article by Wang Lan [3769 5695] of the Agricultural Power Department of the Ministry of Water Conservancy and Electric Power: "Unified Design Technology Discussion Meeting on the SFW and SF 100-800 KW Hydraulic Turbine Generator Series"]

[Text] As small hydroelectric power develops and as new techniques are applied, the series of hydraulic turbine generators of less than 500 kilowatts uniformly designed at the beginning of the 1960 cannot satisfy current needs anymore. Under this situation, some regions have technically improved or renovated small hydroelectric generators. Although such efforts have improved the technology of small hydroelectric generators, they have also created a variety of models and a lack of uniformity in structure.

To adapt to the needs in the development of small hydroelectric power in our nation and foreign markets, it is necessary to quickly develop a unified design for a new series of generators on the foundation of reorganizing and improving the original series of generators. For this, the general Electrical Engineering Bureau of the First Ministry of Machine Building and the Agricultural Power Department of the Water Conservancy and Electric Power Ministry jointly held a Unified Design Technology Discussion Meeting for the series of SFW and SF 100-800 KW hydraulic turbine generators in Tianjin from 9 to 12 March of this year. Participating in the meeting were delegates from the Tianjin Electrical Transmission Design Research Institute of the First Ministry of Machine Building, the Research and Design Institute of the Sichuan Provincial Machinery Industry Bureau, Zhejiang Provincial Machinery Science Research Institute, Chongqing Electrical Motors Plant, Yichang City General Electrical Machinery Plant, Zhejiang Linhai Electrical Machinery Plant and user representatives of the water conservancy and hydroelectric power departments of the 12 provinces (regions) of Guangdong, Zhejiang, Sichuan, Hunan, Guangxi, Yunnan, Guizhou, Jiangxi, Fujian, Hebei, Jilin and Gansu.

At the meeting, the Tianjin Electrical Transmission Design and Research Institute of the First Ministry of Machine Building represented the leading group in unified technical design of the new series and reported on the progress in the

[illegible] design of the SFW and SF series of 100-800 KW hydraulic turbine generators and the method of excitation of the generators used. Then, attending delegates conducted conscientious discussion of the "design manual of the SFW and SF 100-800 KW hydraulic turbine generators (draft)" and the "technical conditions (draft)." The delegates also presented some opinions and proposed requirements for some concrete technical questions such as the various types of excitation used in the new series; multiples of the rotate velocity of the generators, short circuit ratios, efficiency, damping coils, number of unwound wires of the stator; the technical properties required when used in regions at high elevations; accessory temperature measuring elements and braking mechanisms needed; on-line and phase modulation operations, and noise during operation, etc. Finally, delegates of the design and manufacturing departments partially revised and supplemented the "technical conditions (draft)."

To enable the design of the new series of generators to better suit the needs of the user departments, the meeting decided that the water conservancy and hydroelectric departments send an additional three user delegates to participate in the work of the leading group for unified technical design of the new series.

Delegates believed this meeting was a good one and they suggested that specialized meetings with the participation of the designers, manufacturers and users should be held more in the future.

9296
CSO: 4013/118

BRIEFS

YUNNAN SMALL-SCALE HYDROPOWER--Since the 3d Plenary Session of the Central Committee, Yunnan's small-scale rural hydropower has invested one-third less than it did before 1979 but during several years of readjustment new growth has been realized. Installed capacity at the end of 1981 had increased by 190,000 kilowatts compared to 1979 and yearly power output had increased by 431.7 million KWH. The province's 126 counties, districts and towns all have small-scale hydropower. The number of brigades with power increased by 1,366 and the number of production units with power increased by 41,285. In 3 years, the province has reorganized the management system of small-scale hydropower and its 14 districts, autonomous prefectures and cities and more than 19 counties have realized integration of construction and management and power generation, supply and usage. During the period of economic readjustment, there has been a cutback in construction projects. Provincial projects have been reduced by five, with commune- and brigade-run operations being reduced by more than 110,000 kilowatts, so the limited funds are going into finishing-up work. In 1981, the province completed the installing of more than 51,000 kilowatts, more than four times the yearly average for the 30 years prior to 1979. Grid construction was also augmented, solving the problem of power supply. [Excerpts] [Kunming YUNNAN RIBAO in Chinese 27 Aug 82 p 1]

GANSU SMALL-SCALE HYDROPOWER--Wuwei County's newly built Huangyang Reservoir hydropower station began operation on the morning of 13 August and its two turbine generators started to feed power into the overall power grid to serve both industry and agriculture. The hydropower station was begun in April 1980. With an installed capacity of 2,000 kilowatts, the station generates more then 8.2 million KWH a year. To date, this county has a total installed capacity of 8,460 kilowatts. [Text] [Lanzhou GANSU RIBAO in Chinese 20 Aug 82 p 1]

CSO: 4013/10

CHINA'S COAL OUTPUT TO DOUBLE BY YEAR 2000

HK151126 Beijing BEIJING REVIEW in English No 41, 11 Oct 82 pp 5, 7

[Text] China plans to double its present annual coal output of 600 million tons by the end of this century, according to a new development program worked out by the Ministry of Coal Industry. China's energy resources include coal, petroleum, natural gas, electric power, biogas, solar and wind energy. The reserves of coal are the most abundant.

Despite tremendous developments since the founding of New China, problems still plague coal production, such as unstable output, an imbalanced scale of mine construction and poor economic results. Thus supplies fall short of the state's growing energy demands. The Ministry of Coal Industry has worked out a new development program for coal production. Under the new program, the tasks for the next 18 years are:

--replace hand operation with mechanized operation as the principal means of mining in the key mines and strive for a fundamental improvement in mine safety;

--diversify coal products and take adequate steps towards coal gasification and liquefaction, and raise the rate of utilization;

--broaden the scope of business to include coal chemicals, coal-electric power joint enterprises and other operations;

--transport coal mainly by railway, ship and pipelines and strive for automation in loading and unloading; and

--raise coal output through enacting effective economic policies, establishing a scientific management system and introducing the responsibility system in production.

To achieve these goals, the Ministry of Coal Industry will adopt the following measures:

--Continue technical transformation of major mines in a planned way and achieve the goal of 56 percent mechanized operations by the end of 1990.

--Strengthen coal mining, shorten the cycle of construction and see to it that the investments achieve the best results. The scale of projects was only 77

million tons in early 1981. This should be expanded to 120 million tons by the end of 1985 and up to 180 million tons by the end of 1990.

--Devote major attention to the building of the anthracite producing center in southeast Shanxi Province, the coke center in central Shanxi, the Huaibei-Huainan Coal Producing Center in Anhui, the Handan Coal Producing Center in Hebei and the Liupanshui Coal Producing Center in Guizhou. The time limit for projects will be shortened from eight years in 1981 to six.

--Make great efforts to develop local small coal pits, especially in energy-short areas.

--Develop coal washing, processing and multi-purpose utilization. The percentage of washed coal will be raised from 34 percent in 1982 to 56 percent by the end of 1990.

--Boldly make use of foreign funds and raise internal funds for technical transformation and expansion projects.

--Establish the system of training workers and cadres by rotation.

CSO: 4010/6

PRC VICE MINISTER VIEWS COAL INDUSTRY'S FUTURE

HK050142 Beijing CHINA DAILY in English 5 Aug 82 p 1

[Text] Yu Hongen, a newly-appointed vice-minister of the coal industry, was a former miner who went into the pit at the age of 15. "I was a miner 40 years ago and I still am," he said. But at the mention of "modernization" his eyes lit up immediately.

Yu Hongen said the ministry is making every effort to put China's coal industry on a road of stable, healthy growth, with the repeatedly declared purpose of achieving still greater economic results.

For the next 10 to 20 years, he said, efforts will be concentrated on mechanizing the major operations in coal cutting, tunnelling and transportation in the pits.

"Coal mines directly under the Ministry of Coal Industry last year produced 335 million tons of coal," he said, "only a small part of the output was produced by cutter-loader combines. In advanced coal-producing countries, combines produce 90 percent of the coal output and even more."

Another goal the ministry wants to achieve in the next 10 to 20 years is multi-purpose utilization of coal. "New coal dressing plants and plants to gasify coal are already on our agenda," he said. These plants are expected to raise the heat utilization rate of coal for the entire country from 28 percent on the average to 50 percent. "This means saving 100 million tons of coal a year," he said.

"As far as financing goes," he continued, "the government has decided to invest more money in the coal industry. We have solicited additional investment of 630 million yuan from provinces which suffer from acute shortages of coal. They provide us with money in return for a guaranteed supply of coal."

CSO: 4010/5

GIANT COAL CENTER IN EAST CHINA UNDER RAPID CONSTRUCTION

Beijing SHIJIE MEITAN KEXUE [WORLD COAL TECHNOLOGY] in Chinese No 7, 12 Jul 82 pp 2-7

[Article by Wu Zhixiang [0702 0037 7534], Geological Engineer of the Planning Department of the Ministry of Coal: "Large Shandong-Jiangxu-Anhui Coal Base in East China Region Is Under Rapid Construction"]

[Text] The Shandong-Jiangsu-Anhui coal base in the East China region refers to the coal fields from Yanzhou to Tengnan, Jining, Zaozhuang in Shandong Province (abbreviated "Lu"), Xuzhou in northern Jiangsu (abbreviated "Su") and Fengpei (including Datun) to Huaibei in Anhui Province (abbreviated "Wan"), Suxian and Huainan and Panji on the two banks of the Huai He in the south. This base spans 300 kilometers from north to south and an average of 60 kilometers from east to west, covering an area of about 20,000 square kilometers. The underground reserves are abundant coal resources. The coal reserves are concentrated, the varieties are complete, the quality is good. The area is situated along the east China coast near Shanghai, Jiangsu and Zhejiang and such areas where the industrial foundations are strong but fuel is lacking. Both water and land transportation are available and it is close to Qingdao, Lianyun Harbor and Shijiusuo seaport via the sea. This benefits coal exports. Therefore, strengthening the development of the coal resources in the Shandong-Jiangsu-Anhui area as one of the major tasks to build up the nation's coal industry and making plans for coal so that we can quickly exploit the abundant underground resources have a very important meaning in satisfying domestic needs and foreign trade.

I. The Natural Geographic Situation of the Base

The Shandong-Jiangsu-Anhui coal base is situated in the ancient Yellow River channel and the alluvial plains of the Huai River. There are some low hills. The elevation is generally about 50 meters above sea level. The ground surface is mostly covered by a thick alluvium of uneven thickness. In the old mining regions of Zaozhuang, Xuzhou, Huaibei and Huainan, it is generally 20 to 100 meters thick. In the new mining regions of Yanzhou, Tengnan, Fengpei, Suxian and Panji, it is generally 50 to 400 meters thick. The

alluvium contains 3 to 4 sandy gravel and water containing layers, and there are also 3 to 4 sandwiched plastic clay layers above and below. They form very good water insulating layers that separate the sandy gravel and water containing layers and prevent the water in the alluvial water containing layers from infiltrating the mine shafts and from causing damage to production and construction of coal mines.

The rivers in this base belong to the two major water systems of the Huang He and Huai He. Those in the southwestern part of Shandong belong to the Huang He system, and those in northern Jiangsu and northern Anhui belong to the Huai He system. The water network is dense and there are many rivers and lakes between the two water systems. Starting in the north in Shandong and Yining, there are the Nanyang Hu, Shaoyang Hu, and Weishan Hu, and in the south in northern Jiangsu there are the Hongze Hu and Gaoyou Hu. Between the Huang He and the Huai He, the south-to-north inland navigational canal with a long history in China is the north-south canal that connects all of these lakes.

The climate of this region is mild and damp. The four seasons are clearly defined. It has the transient climatic characteristics from our nation's southern climate to the northern climate. From north to south, the annual average temperature increases from 12°C to over 16°C. The average temperature of the coldest month (January) is 4°C below zero to 1°C. The frostless period throughout the year lasts 6 to 7 months. The annual rainfall is 600 to 900 millimeters. In the Huai He area in Anhui, the annual rainfall is concentrated in the summer flooding period. Spring drought and summer waterlogging easily occur. Because of the efforts to control the Huai He on a large scale after liberation, the ability of this region to resist drought and waterlogging has greatly increased.

II. Geological Situation in the Coal Fields

This base mainly contains the coal containing geostrata of the Palaeozoic Carboniferous Period and the Permian Period coal series, generally called the Carboniferous-Permian Period. The Taiyuan Series of the upper Carboniferous Period and the Shanxi Series of the middle Permian Period belong to the North China sedimentary type. The Shihezi Series of the upper Permian Period does not contain exploitable coal seams in the North China region. The northern Jiangsu and northern Anhui areas contain major exploitable coal seams. The form of sedimentation is somewhat similar to the Leping coal series in the southern part of our nation, therefore it is also commonly called "northern type and southern facies" coal fields.

The Taiyuan Series of the Carboniferous Period is an alternate marine and continental facies deposit. It contains 10 to 13 thin layers of limestone with intercalations of sandstone, shale and sandy shale, and 3 to 4 exploitable coal seams. The total average thickness that is exploitable is about 4 meters.

The Shanxi Series of the Permian Period is a continental facies lacustrine deposit. It consists of sandstone followed by shale and sandy shale. It contains 2 to 7 coal seams and the total average thickness that is exploitable is 4 to 16 meters.

The Shihezi Series of the Permian Period is also a continental facies lacustrine deposit. Its major rock layers are sandstone, shale and sandy shale. The middle and lower parts contain 2 to 5 coal seams. The total average thickness that is exploitable is about 5 meters.

The lower part of the Carboniferous-Permian Period is an unconformity over the limestone of the Ordovician Period and the Cambrian Period. The Ordovician Period and the Cambrian Period are original layers of limestone. The layer of limestone form low hills and they are very good building materials. They contain an abundance of water and they are very good local sources of water in deep layers.

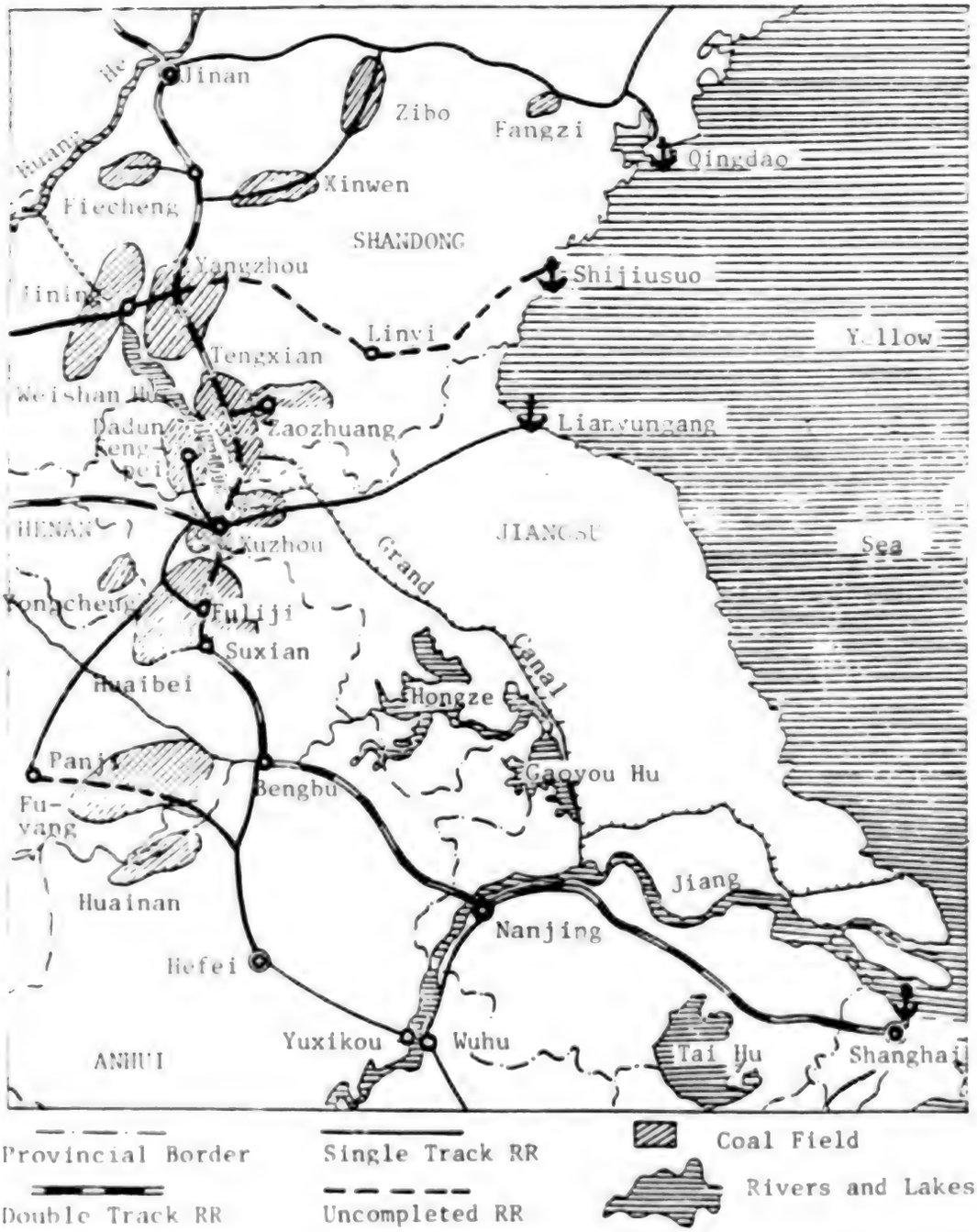
The major geological tectonic shape of these coal fields is the compound syncline, forming many slow anticlinal and synclinal tectonics generally in the northeast-southwest strike. The angle of inclination is generally 10° to 30°. The angle of inclination of the coal seams of individual productive mine shafts in the old mining regions of Huainan is over 45°.

III. The Situation of Present Production and Construction

The Shandong-Jiangsu-Anhui coal base will be a key region of our nation's coal industry at present and for a relatively long period into the future. In this base, there are now four productive old mining regions at Zhaozhuang in Shangdong Province, Xuzhou in Jiangsu Province, Huaibei and Huainan in Anhui Province. Near these old mining regions are five new mining regions at Yanzhou and Tengnan in Shandong Province, Fengpei (including Datun) in Jiangsu Province, Suxian and Panji in Anhui Province which are being developed at present on a large scale. In addition, in this base, there are also the new coal fields at Jining in Shandong, Yingshang in Anhui. Forces are being concentrated to conduct geological prospecting.

In this base, there are 51 productive mine shafts producing over 50,000,000 tons of raw coal, including 10,000,000 tons of coking coal and washed coal concentrates. These producing mines are conducting technical improvements at present to improve the degree of mechanization and to expand the productive capability.

At present, the five new mining areas at Yanzhou, Tengnan, Fengpei, Suxian and Panji are constructing 12 large mining shafts. The annual designed capability is over 30,000,000 tons. In addition, there are some new shafts that are being designed, and preparations are being done for drilling the mine shafts, including the building of railroads, highways, power supply, water supply, communications, living quarters, leveling the land for plants, i.e., the "three types of communications and one leveling" work prior to the official beginning of building mine shafts. The coal resources and the conditions of transportation in this region indicate that it is entirely possible to develop the production of this region to an annual 150 million tons within this century.


Jinan
Zibo
Fangzi
Qingdao
Xinwen
Tiecheng
SHANDONG
Yangzhou
Shijiusuo
Linyi
Tengxian
Yellow
Weishan Hu
Zaozhuang
Lianyungang
HENAN
Xuzhou
JIANGSU
Sea
Grand
Canal
Fuliji
Suxian
Huaibei
Hongze
Panji
Gaoyou Hu
Bengbu
Fu-
yang
Jiang
Huainan
Nanjing
Hefei
Yuxikou
Wuhu
Tai Hu
Shanghai
ANHUI
Provincial Border
Single Track RR
Coal Field
Double Track RR
Uncompleted RR
Rivers and Lakes

In this base, there are over 400,000 workers belonging to the coal industry system. Besides those engaged in production and construction, there are also four design academies and several geological prospecting teams and scientific research institutes. In the manufacturing of coal mining equipment, there are many general machinery manufacturing plants and also three large special coal mining equipment manufacturing plants at Xuzhou, Yanzhou and Huainan. They produce special equipment for building coal mines, for coal production, metal supports used in the coal face, automatic hydraulic props and such necessary equipment. At the same time, each mining area also has many machinery repair shops that handle equipment maintenance and supply accessories to guarantee the needs in the production and building of coal mines.

In coal mining technology and training of managerial personnel, a strong team is being trained in actual work at the current production and construction posts on the one hand, and on the other hand, special coal mining schools are training high level and mid-level technicians and managerial cadres. In this base, there are the three higher educational institutions of the China Mining Institute, the Shandong Mining Institute, and the Huainan Mining Institute with a relatively complete staff. At the same time, there are several middle and technical schools.

Therefore, in this base, not only is there an abundance of underground coal resources, a complete foundation for the future development of the coal industry has been established at present in production and construction or in the training of talent and equipment manufacturing. On this basis, we have very superior objective conditions to develop the potential of productive shafts, to renovate, to improve and to hasten the building of new mine shafts.

IV. Favorable Conditions for Hastening Construction

(1) The Coal Reserves Are Concentrated, the Types of Coal Are Complete, the Quality of Coal Is Good

Under the expansive alluvial plain from south to north spanning 300 kilometers between Yanzhou in Shandong and Huainan in Anhui are continuous coal fields with a very rich reserve. After geological prospecting, we have found a known reserve of over 30 billion tons. At present, we are still expanding the range of prospecting and the reserves continue to increase. The general distribution is: over 7 billion tons in the Yanzhou, Tengnan, Zaozhuang and Jining areas in Shandong; over 3 billion tons in the Xuzhou-Fengpei area in Jiangsu; over 20 billion tons in the Huaibei, Suxian, Huainan and Panji areas in Anhui. In addition, the Yongcheng Coal Fields in Henan Province neighboring the Huaibei coal fields in Anhui also contain abundant superior quality anthracite. These are not included in this base.

The varieties of coal are complete and the quality of coal is also very good. The major coal type is gas coal, followed by coking coal, fat coal and a small amount of anthracite. The individual fields and shafts in the Fengpei coal

fields contain igneous rock intrusions which changed the coal seam into natural coke. The Shanxi Series and the Shihezi Series of the Premian Period are situated in the upper part of geostrata of the coal seams. They contain the main exploited coal seams. Yanzhou and Jining have gas coal. Zaozhuang and Tengnan have gas-fat coal and fat coal. Xuzhou and Fengpei have gas coal, gas-fat coal and fat coal. Huaibei and Suxian have gas coal, gas-fat coal, primary coking coal and small amounts of anthracite. Huainan and Panji both have gas coal. The ash content of raw coal is generally about 15 percent. After washing, the ash content of coal concentrates is 8 to 9 percent, the sulfur content is below 1 percent, the thermal output per kilogram is 6,000 to 7,000 kilocalories. The coal types of the coal seams of the Taiyuan Series of the Carboniferous Period and those of the Shanxi Series and Shihezi Series of the Permian Period are the same, only the sulfur content is higher, generally about 2 percent. After washing, this can be reduced to 1.5 percent. The washed coal concentrate for coking in this base has guaranteed in a key way the steel bases of Ma'anshan in Anhui and Shanghai Boashan under construction. A large amount of gas coal and washed medium coal for coking are supplied to the East China region to generate electricity as power generating coal. The productive mining areas in Zaozhuang, Huaibei and Xuzhou also export coal.

(II) The Geographical Positions Are Good, Water and Land Transportation Are Convenient

This base has a flat topography and transportation is convenient. There is the Jin-Pu [railroad] line running from south to north and the big canal. There is the Longhai Line running from east to west. The coal fields are all located on the two sides of these lines.

The port of Shijiusuo is 300 kilometers east of Yanzhou in Shandong. There is a special pier for coal at Shijiusuo that can accommodate 10,000-ton ships. It is being intensively built with the cooperation of Japan's Foreign Assistance Fund. There is a railroad from Yanzhou westward to Heze. In the future, extensions westward can connect with the Jing-guang line, forming an east-west trunk line parallel to the Longhai line. In this way, the coal from the southern part of Shanxi and the northern party of Henan can be exported from Shijiusuo via Yanzhou. This greatly shortens the distance of railroad transport and is beneficial to using the large amount of coal in Shanxi and Henan provinces to support the East China area and export needs.

The Jin-Pu and Longhai lines intersect in the Xuahou mining region. It is only 223 kilometers from Lianyun Port in the east. At present, the coal of Zaozhuang, Huaibei, and Xuzhou are all loaded and exported from Lianyun Port or transferred to Shanghai and such coastal ports. Fengpei (including Datun) are on the banks of the canal. There are already branch lines that connect with the Longhai line.

Besides the Jin-Pu line in the Huaibei and Suxian mining regions, there are also the Suifu line to Fuyang in Anhui. Huainan and Panji have branch lines that connect with the Jin-Pu line via Bangbu, and there is the Huainan line that directly connects Yuxikou on the banks of the Chang Jiang. The coal can be

shipped along the Chang Jiang to Nanjing, Shanghai or directly loaded on ships for export. Huainan and Panji are situated on the two banks of the Huai He. After further dredging of the Huai He, it will connect with the Grand Canal and the Chang Jiang, forming a criss-cross sea-land network consisting of the canal or the Chang Jiang and the railroads and ocean shipping. This is beneficial to coal-poor Shanghai, Jiangsu and Zhejiang and to export trade.

(iii) The Industrial and Agricultural Foundations Are Good

The provinces along the coast of eastern China centered around Shanghai have a strong industrial and agricultural foundation. The total value of industrial production in the East China area constitutes over one-third that of the whole nation. Steel, light industry, the chemical industry, the cement industry and the machinery manufacturing industry are all relatively developed. These mining regions generally are all close to large and medium cities. Materials, equipment and technical strength can be provided nearby for the production and development of coal mines. Basically, we can make prior arrangements for complete equipment for mines within the East China area according to plan.

The climate of the East China area is warm, the soil is fertile, agriculture is also very developed. Sufficient agricultural sideline products can be provided locally to the residents in the mining regions. This is very beneficial to improving the living standard of the workers and families in the mining regions. The area in northern Anhui used to be an area of changeable drought and floods and an "area flooded by the Yellow River" in the past. The people's life was very harsh. After liberation, results have been achieved in the dredging of the Huai He and in building water conservancy. Now, we are planning to make it into one of our nation's major commercial food grain bases.

The strong industry and developed agriculture in the Huadong area are all firm backups for the construction of coal mines and a firm foundation for the continued development of coal mining.

(iv) New Mines Possess Mature Technical Standards

The geological characteristics of this base are a stable coal seam with a rich reserve and a thick alluvial layer with deep shafts. People generally compare it to "fat flesh and thick skin." This has increased the technical difficulties in drilling vertical shafts. But, with an accumulation of 30 years of experience in construction and by combining design, scientific research and on-site construction, and under the coordination of the nation's machinery manufacturing departments, the technical difficulties were solved. The present well sinking team at the coal mines has already skillfully grasped the various methods and techniques of sinking vertical shafts in sinking wells, freezing, curtain grouting and the use of large drilling

equipment. Now, practice proves that workers can confidently sink wells and smoothly complete the tasks of production in alluvial layers of about 300 meters thick and which contain relatively more water after continued improvement of the worker's technical skills and continued improvement in construction equipment.

The roller coal cutter and automatic hydraulic props are commonly used in coal faces in coal mine production. Many drill platforms for rocks and rock loaders are commonly used in the tunneling faces. They have continued to improve the degree of mechanization of mines. After raw coal is produced, it must be processed, washed and screened to improve the quality of coal.

(V) We Can Establish a Comprehensive Base for Coal, Electric Power Centered Around Coal

This base has relatively rich coal reserves and underground sources of water. There is coal and there is water. When taking coal as the center, coal and electric power must be coordinated first. We can build large thermal power stations at the mouth of the coal pits to transmit electricity to the Huadong Power Network and form a large coal and electric power base. Second, we can carry out coking and gasification using coal as raw material to develop chemical fertilizers, chemical fibers, medicine and such industrial products. The low hills near the mining areas are mostly thick layers of limestone of the Cambrian Period and the Ordovician Period. The geostrata of the coal seams contain superior quality clay. We can develop the conditions of sufficient fuel and electric power of the locality to develop such industries as cement, porcelain, refractory clay and smelting of nonferrous metals. At the same time, we should correspondingly push forward the development of machinery manufacturing, the light and textile industries and the electronics industry. The formation of the industrial and mining towns of Xuzhou and Huainan all went through such a course of development. The preliminary idea is that in the future, we can develop large coal gasification stations at the locality or nearby, produce urban coal gas, use pipelines to transport it to large and medium cities such as Hefei and Nanjing and even Shanghai so that these cities can realize coal gasification for fuel, protect the environment and reduce pollution.

The natural conditions and transportation conditions in this base are very similar to those of the Ruhr District in West Germany. If we start out from coal and take coal as the center in this region to carry out comprehensive utilization and comprehensive management in a big way and renovate our nation's current industrial structure, we can gradually form a large and complete comprehensive base of coal, electric power, chemical industry, building materials, light industry and agricultural and sideline industries.

In general, based on the objectively favorable factors above, we possess the conditions and the technology is reliable to first hasten the production and

of this coal base. We must mainly rely on our own strength, be self-reliant and struggle hard. At the same time, we are also willing to develop cooperation in many ways with friendly nations on the basis of equal and mutual benefits via government-to-government and people-to-people compensatory trade, joint capital management and accept loans. We firmly believe that in the not too distant future, we will promote the greater development of the entire industry and agriculture by starting out from hastening the development of coal in this region and we will make greater contributions to our nation's four modernizations.

4296
CSO: 4013/142

NEW RAIL LINKS, SLURRY PIPELINES UNDER STUDY FOR SHANXI COAL BASE

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 3, 25 Jun 82 pp 11-12

[Article by Hu Guangrong [5170 0342 2837] of the Transportation Research Institute of the Scientific Research Academy of the Ministry of Railways: "Transportation Problems in the Construction of the Coal Base in Shanxi"]

[Text] Energy resources are important material foundation for national economic development. Coal constitutes 70 percent of our nation's energy resources. To ease the shortage in the supply of energy resources in our nation, developing coal well is a problem of strategic significance in guaranteeing national economic development.

During the current period of readjustment of the national economy, the state's investment capability is limited. Superior coal bases must be selected for development so that construction can be rapid and the economic results can be good. Coal bases in Shanxi have large reserves. There are all types of coal. The quality of coal is good. Coal is buried at a shallow depth. The mining conditions are good. The geographical locations are convenient. All of these are superior conditions. Since liberation, Shanxi has produced large amounts of coal to support the various localities throughout the nation and the amount of coal shipped to other places has increased year after year. Since 1977, the amount of coal shipped away has increased annually by an average of about 10 million tons.

In view of current transportation and future development, one of the key problems in developing Shanxi coal is railroad transportation. Because of insufficient transportation capabilities, in 1980, over 14 million tons of coal accumulated in Shanxi Province. The local coal mines basically determined production by the amount transportable. Therefore, the development of Shanxi coal must emphasize the buildup of the railroads and related harbors.

Shanxi Province now has five railway trunk lines and six outlets. Total transportation capacity is about 110 million tons. In 1980, the actual amount of various types of commodities shipped out was 99 million tons, including 72 million tons of the province's coal. The percentage of utilization of transportation capabilities has reached saturation while the accumulation

[illegible] the currently available railroads in Shanxi Province and the strength of local concentralization and shipping cannot satisfy the needs in shipping coal to other places. The accumulation of Shanxi coal is not only due to the deficiencies in the capacities of the railroads and centralization and shipping capabilities, one reason is the insufficient supply of empty railroad cars. With the shortage of railroad cars, this problem is very difficult to solve within a short period if the number of freight cars is not massively increased. To quickly build up the Shanxi energy base, problems related to the buildup of transportation should be solved well.

1. Distribution of Coal Production and Transportation Buildup Must Be Uniformly Planned, Only Overall Arrangement Can Hasten the Progress of Construction and Improve Investment Results

In this way, we can avoid the present inability to ship out the coal that has been mined because of insufficient transportation capabilities in Shanxi and Guizhou. The railroad to the Helinhe and Yiminhe mines have been completed but the coal mines have not been developed and there is no coal for the railroad to transport. Therefore, in the buildup of the Shanxi coal base, the buildup of transportation must be arranged well, such as the building of railroad trunk lines, branch lines and special railroads within the province, continuation of the trunk lines outside the province and easing the flow of traffic and strengthening harbors. The transportation channels for coal from the producing region to the consuming region must form a comprehensive transportation capability before we can guarantee that the production of coal in the Shanxi coal base and the shipment of coal to other places are normal.

We should first build the northern, central and southern railroads and the harbor for shipping Shanxi coal to other places.

Second, the various methods of transportation of Shanxi coal to other places must be comprehensively utilized. The present capacity of the Jing-Guang line and the Jin-Pu line to ship coal from the north to the south is insufficient and they cannot meet the task of transporting more Shanxi coal to the south. Waterways must be fully utilized for shipping. When utilizing coastal navigational lines to ship coal to eastern China and Guangdong and Guangxi, we should also pay attention to the utilization of the Grand Canal. Investment in the canal (Xuzhou-Chang Jiang section) amounted to 300 to 400 million yuan. The transportation capacity can be increased to 40 million tons. This can share the freight load of the Jin-Pu line. The transportation cost is low and it also has such comprehensive benefits as irrigation.

Because Shanxi has a complex topography, railroad construction is more difficult. We should study the problems of high voltage transmission of electricity and the transportation of coal via pipelines. In the future, washing and screening

[illegible] will be strengthened and a large amount of washed coal and [illegible] will be produced. We should utilize washed coal where there are allowable water sources to build power stations at coal mines. This will not only satisfy the needs within the province, we can also build 500,000-volt power transmission lines to transmit electricity to nearby Beijing, Shijiazhuang and Zhengzhou, all within a distance of 300 kilometers. To ship more Shanxi coal to other places, we should actively study coal transporting pipelines. Based on the fact that Shanxi is relatively poor in water sources, it is possible to build a coal slurry pipeline 720 mm in diameter that can transport 12 million tons of coal using 0.5 the amount of the water flow.

Building of railroad branch lines and special lines to serve local coal mines should be planned on an overall basis. We cannot lay tracks everywhere simply because of need. After completion of the 7 branch lines and 29 special lines planned for Shanxi Province, and with the original branch lines and special lines, the railroad trunk line will become a centipede, and there will be difficulties in organizing transportation on the trunk line, the efficiency of transportation will drop, and this will create a passive situation in which all the branch lines are moving but the trunk line is jammed. Therefore, we must quickly study the situation and plan rationally.

. The Development and Distribution of Coal Should Pay Attention to Rationally Utilizing Resources and Improving the Quality of Coal. The past policy of "taking steel as the key link" has created a situation in which more coking coal is mined but less power coal is mined. At present, the whole nation produces over 200 million tons of coking coal, surpassing the needs of the metallurgical industry. A lot is used as power coal and burned away. Precious coking coal resources are wasted. There is a surplus output of coking coal along the Nantongpu line in Shanxi. A large amount is burned to become indigenous coke. This wastes resources and pollutes the environment. Therefore, when developing Shanxi coal, we should emphasize the development of the Daning power coal fields and the Xinshui anthracite fields to guarantee that the needs for power coal and anthracite used in chemical engineering are satisfied. The coking coal fields at Xishan, Hexi and Hedong should be appropriately developed according to domestic and export needs to conserve coking coal resources.

Second, we should strengthen the washing and screening of coal and reduce the amount of useless transportation. Now, the output of coal in Shanxi constitutes one-fifth the total national output. The capacity to wash and screen coal constitutes only 7 percent of the whole nation. After the major mines in Shanxi realized mechanized mining, the ash content of coal has increased greatly. In 1979, the ash content and rock content at the Yangquan Mine reached 23.3 percent, and the contents reached 22.3 percent at Fenxi. The percentage at Xishan was 18.2 percent. Local mines and small coal pits not wash and screen their coal. If 40 percent of the output of coal throughout the province are washed and screened, the average ash content can be reduced by 4 percent. Calculating at an annual output of 200 million tons, the weight of useless transportation by the railroads would be reduced by 8 million tons

a year, and this would conserve 5 billion tons-kilometer in railroad transportation and 50 million yuan in transportation cost. This will ease the pressure on the railroads in shipping Shanxi coal to other places on the whole.

3. Railway Construction Should Learn the Lesson of the Wrong Direction of Investment in the Past and It Should Selectively Utilize the Limited Amount of Investment. The anthracite of superior quality produced in the Jindongnan Prefecture is the raw material urgently needed by medium and small chemical fertilizer plants throughout the nation at present. Now, because of an insufficient number of freight cars, a lot has accumulated and cannot be shipped out. In 1980, the amount of coal shipped out constituted 50 percent of the output of the prefecture. It is a prefecture in the province with the lowest amount of coal shipped out. Other provinces that urgently need coal have utilized a large number of automobiles and tractors to transport coal out of Shanxi. Some are reloaded onto trains in Henan Province. Calculating at 3 million tons and an average shipping distance of 70 kilometers, the annual transportation cost is about 42 million yuan and 20,000 tons of petroleum. The expenditure for railroad transportation is only 1.5 million yuan and 1,200 tons of petroleum. Therefore, quickly arranging the project to build a duplicate railroad for the Changzhi-Xinxiang segment and its electrification with an investment of over 300 million will enable over 10 million more tons of coal to be shipped out each year. This can fully develop the productive capabilities of the local coal mines and conserve a lot of transportation cost and petroleum.

Because the potential for increased output of Shanxi coal is great, because the investment in railroad construction is large, and because the period of construction is long and rebuilding is difficult, the railroads will become a factor limiting the increase in the output of coal within a definite period. Therefore, in constructing new railroad lines to ship Shanxi coal to other places, we should consider building railroads according to the criteria for special railroads to transport coal (operating long trains). The investment will not increase too much but the transportation capacity can be increased by onefold.

4. Under the Present Situation in Which State Investment Strength Is Limited, It Is Suggested That Shanxi Province Mobilize Local Financial Forces and Manpower To Purchase Special Rolling Stock and Build and Repair Regional Railroads in Order To Hasten the Progress in Building Shanxi's Energy Base. At present, railroad rolling stock manufacturing plants have surplus productive capabilities. Regional coal mines in Shanxi Province can make investments to purchase special coal transporting cars to increase the capability to ship coal out. An investment of 25 million to 30 million yuan will purchase 1,000 freight cars that can transport 5 million to 6 million tons of coal more a year.

The construction and improvement of small local coal mines must be combined with the building of large warehouses for coal storage while trucks are being used to transport coal to the railroad stations for centralized transport so that the coal can be quickly loaded. Without loading facilities and using manual labor to load the cars in unpackaged form, it is difficult to complete the task of shipping out large amounts of coal. The time for loading and unloading is lengthened and this will surely delay the turnaround of the cars. When investment in railroads and the number of freight cars are insufficient, coal will necessarily accumulate and it will not be shipped out in time for sale. This affects the turnaround of capital of the coal mines.

9296
CSO: 4013/123

ACADEMY OF SCIENCES HELPING TO PLAN COAL SLURRY PROJECT FOR SHANXI

OW120628 Beijing XINHUA Domestic Service in Chinese 0026 GMT 11 Aug 82

[Excerpts] Beijing, 11 Aug (XINHUA)--XINHUA editor's note: The Chinese Academy of Sciences has taken the initiative in providing scientific and technological service for the construction of coal energy bases in Shanxi. This is a very good thing. It will certainly promote the building of coal energy bases in Shanxi and the development of the scientific research work of the academy. The spirit and initiative of the scientific research unit in serving actual production work really deserve recommendation. (end editor's note)

In mid-July, the Chinese Academy of Sciences dispatched an investigation team to Shanxi Province to study the actual conditions there and prepared an important, comprehensive plan for the scientific and technological development of coal bases in Shanxi Province. The Chinese Academy of Sciences has thus closely linked scientific research work with national economic construction. Its action was highly appreciated by concerned departments in Shanxi and at the central level.

Its research projects include the mixing of coal dust with water and using coal slurry [shui mei jiang 3055 3561 3364] to replace heavy oil. At present, many countries in the world are attaching great importance to the study of coal slurry. The Chinese Academy of Sciences has done a lot of research work and achieved much. Coal slurry cannot only replace heavy oil and greatly raise coal's economic results but can also be transported through pipes. This will alleviate the transportation problem, which has obstructed the development of the coal industry in Shanxi Province for a relatively long period.

At present, various research institutes under the Chinese Academy of Sciences are making specific plans for their respective activities. A responsible person of the Chinese Academy of Sciences said: "Going to production units to fund research subjects and serving the national economy are the firm principles of scientific research work and also the honorable tasks of scientific research departments. Basically, production needs science and scientific research work cannot separate itself from actual production. The integration of scientific research with the practice of production will certainly promote the development of the national economy and scientific research work in an effective manner."

SHANXI EXCEEDS COAL EXPORT PLAN FOR FIRST HALF OF 1982

Taiyuan SHANXI RIBAO in Chinese 4 Jul 82 p 1

[Article by Correspondence Unit, Provincial Coal Import and Export Company: "Produce More Coal, Export More Coal, and Create More Foreign Exchange; Our Province Exceeds Coal Export Plan During First Half of Year"]

[Text] By 26 June, four days ahead of schedule, our province had exceeded its coal export plan for the first half of the year by 104,000 tons. Of the total, exports of coal from local coal mines exceeded the plan by 3,912 tons. The total export from local coal mines represented an increase of 174 percent over the same period of last year and it established the best record in the export history of our province's local coal. Relatively good results were also achieved for the various economic targets.

The export of local coal in our province was formally included in the state plan this year and has been given important attention by related departments. The provincial coal import and export company as well as the import and export companies of Yanbei region and Datong Municipality regularly organize personnel to enter into the first line of production. They have organized the sources of supply on a timely basis, established and perfected the system of daily reporting, five-day reporting, and 10-day reporting, developed information on coal shipments and transfers and on the port calls of foreign vessels, and actively organized for coal deliveries at the ports. The railway departments have allocated cars on a timely basis and organized shipments according to plan, so that the work of coal export has gradually become normalized. In order to improve coal quality and reduce tonnage deficits, various measures have been established. Special personnel were assigned to be responsible for quality control in various critical steps, from analysis of coal quality, screening breakage, cleaning of wastes, measuring and marking and cleaning of the cars to loading and dispatch. Car loading personnel were specially organized to study and improve loading techniques where car leveling equipment and railway scales are lacking, so that tonnage deficits were reduced, economic losses created by such deficits were avoided, and the plan for the first half of the year was exceeded while quality and quantity were assured.

5974
CSO: 4013/133

NEW MINES APPROVED FOR ANHUI COAL CENTER

OW301131 Beijing XINHUA in English 0839 GMT 30 Sep 82

[Text] Hefei, September 30 (XINHUA)--The State Planning Commission has approved a proposal from Professor Hua Luogeng, China's leading mathematician, and other scientists for starting 16 new mines from now to 1995 at the Anhui coal center, in addition to the six now under construction, the Anhui Provincial Corporation of Coal Industry announced.

The 16 mines will be designed to produce 34.6 million tons of coal a year, the corporation said.

The commission also approved a unified plan for the construction of electric power, transport and other supporting projects for the coal center situated along both banks of the Huai He River. Development of coal resources in this area is vital to the economic construction in Shanghai and the six east China provinces, which furnish one-third of the country's gross industrial and agricultural output value.

The Anhui Provincial Coal Industrial Corporation has instructed its divisions to work out specific plans in the light of the proposal which Professor Hua and a group of scientists reported on at a Beijing meeting last July after three months' on-the-spot investigations and study.

The investigations were made at the request of Gao Yangwen, minister of coal industry. Professor Hua is concurrently general adviser of the consulting service of the China Association for Science and Technology.

The scientists, who were from seven societies under the association, twice went to the coal center between April and June and studied--using a mathematical method for seeking the best of many options--ways of accelerating its development.

CSO: 4010/2

DATONG DAILY COAL PRODUCTION NOW OVER 70,000 TONS

Taiyuan SHANXI RIBAO in Chinese 30 Apr 82 p 3

[Article by Li Bacheng [2621 0360 2052] and Yang Xiaoning [2799 1420 1380]: "Comprehensive Mining and General Mining Are Carried Out Together, High Output, Stable Output and Balanced Production Are Realized, Datong Mining Bureau's Daily Production Level Remains Over 70,000 Tons for 100 Days"]

[Text] The Datong Mining Bureau insisted on the policy of starting from the actual situation in everything and sought truth from facts to solve the relationship between comprehensive mining, general mining and blast mining. A good situation has emerged in production. Up to 10 April, this bureau has continuously realized stable output, high output and balanced production for 100 days, and the daily output has been maintained at more than 70,000 tons.

In recent years, the Datong Mining Bureau installed and used 29 sets of imported and domestically manufactured comprehensive mining machinery. They have served greatly to increase the output of coal. During the first quarter of this year, the output from comprehensive mining by the whole bureau has already constituted 40.2 percent of the total output from stoping, equivalent to the output of 79 general mining teams. Datong Coal Fields have more coal seams. Some coal seams do not have a uniform thickness. Currently available comprehensive mining machinery is only suitable for coal seams of medium thickness. A fairly large portion of the thick coal seams and thin coal seams and coal seams in complex geotectonics and edges of coal pits can only be mined by general and blast mining methods. Therefore, to realize balanced production, the bureau must seek truth from facts to solve the relationship between comprehensive mining and general and blast mining. While developing the function of the comprehensive mining machinery and carrying out modernized coal mining, the function of general and blast mining cannot be neglected.

To improve the unit output of general blast mining, this bureau first adjusted the leading forces and added personnel. The 110 general blast mining teams of the whole bureau generally added 20 people and 9 additional teams were organized. The Bureau and mine both grasped technical training for the general blast mining teams, ordered team members to take leaves for training and provided training after work. Key technical workers all received training at

at once. The technical standards of the workers were improved through technical learning, on-site operation, on-the-job training and strict examination. They also strengthened electro-mechanical facilities and management of the quality of construction at general blast mining sites and faces. They prepared sufficient accessories, organized special people to carry out scheduled maintenance, broadly used the methods of having the elementary shift contract the work of maintaining machinery, letting small shifts work in subsections, registering names of workers who took care of the machinery and assigning responsibility to the individuals. The percentage of equipment in good condition reached 89.2 percent. The percentage of qualified mining faces reached 98 percent. These efforts have created a good condition for normal production and provided sufficient work for general blast mining.

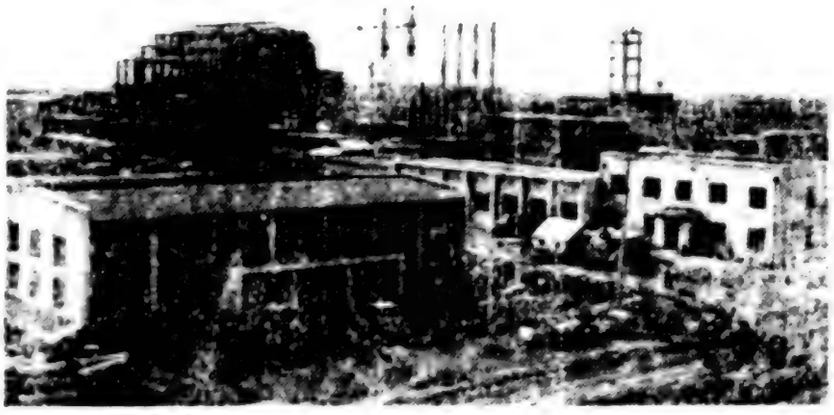
During the first quarter of this year, the Datong Mining Bureau produced 4.68 million tons of raw coal. The output from general blast mining constituted more than 50 percent. Comprehensive mining and general mining were carried out together, high yields and stable output were realized, the daily output level stabilized at above 70,000 tons.

9296
CSO: 4013/90

NEW PLANT IS NATION'S FIRST TO PRODUCE COAL GAS FROM LIGNITE

Beijing RENMIN RIBAO in Chinese 26 Jul 82 p 1

[Photograph Caption]



[Text] The Shenyang Gas Works, under construction for more than 2 years, is now taking shape. It will be China's first plant to produce coal gas from lignite (a poor quality coal). The project has a designed daily production capacity of 540,000 cubic meters of coal gas and when completed, the city can add another 250,000 coal gas consumers.

CSO: 4013/135

PROSPECTS FOR COAL-BED METHANE RESOURCES EXPLORED

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 5, 25 Jun 82 pp 2-4

[Article by Wang Chijie [3769 3069 7132] and Feng Tianyuan [7458 1130 0337]: "Outlook on Gas Resources From Coal"]

[Excerpts] The scattered coal-forming substances in the coal seams and geostrata of coal measures undergo a series of physical-chemical reactions in the process of coalification and produce large amounts of gaseous carbon and hydrogen compounds. This combustible gas mainly consisting of methane is called coal-formed gas. Ordinarily, as the metamorphic stages of coal increase, more coal-formed gas is formed. According to some foreign test results, the amounts (cubic meters/ton of coal) of coal-formed gas produced by the various grades of coal are as follows:

Lignite	Flame coal	Gas coal	Fat coal
68	168	212	230

Coking coal	Lean coking coal	Lean, semi-anthracite	Anthracite
270	287	330	>400

After coal-formed gas is formed, a part disperses into the atmosphere, another part adsorbs to the surface of the minute inner crevasses of the coal seams or is dissolved in underground water, and still another part becomes free and migrates into the pores of nearby geostrata or crevasses to form gas deposits.

II. Our Nation Possesses Favorable Geological Conditions for "Generating, Storing and Capping" Coal-Formed Gas and Geological Structures

The periods of coal formation in our nation are many. They are mainly the southern early Carboniferous Epoch, the North China Carboniferous-Permian Period, the southern Permian Period and the late Triassic Epoch, the northern early-middle Jurassic Epoch, late Jurassic-early Cretaceous Epoch, and the Tertiary Period. Coal containing geostrata are widely distributed in all of

our nation's provinces (regions). The geostrata of the coal measures are thick and they mostly belong to alternate marine and continental facies or inland lacustrine facies deposits. They frequently contain relatively thick carbonaceous mudstone or oil shale. They are the source rocks for forming coal-formed gas.

Many coal containing basins frequently have 2 to 3 sets of geostrata of coal measures of continuous or overlapping deposits, thus increasing the thickness of the source rocks that produce coal-formed gas. For example, the Ordos Basin has three sets of continuous deposits of coal containing geostrata, the Carboniferous-Permian System, the upper Triassic Series and the middle-lower Jurassic Series. Their cumulative thickness is more than 1,000 meters. Certain regions in southern China have the Ceshui coal measures and Longtan coal measures, or overlapping deposits of the Longtan coal measures and the Anyuan coal measures. The Sichuan Basin has overlapping deposits of the Longtan coal measures of the late Permian Epoch and the Xujiahe coal measures of the late Triassic Epoch. The coal measures of the Carboniferous-Permian Period, the coal measures of the Jurassic Period and the coal measures of the Tertiary Period that constitute over 85 percent of our nation's coal resources contain very thick coal seams that range from over 10 meters to several dozen meters and even to over 200 meters. They are the rich material foundations for the formation of coal-formed gas.

In the geostrata of the coal measures, relatively thick sandstone and limestone are frequently developed. They are the depository strata of free coal-formed gas. Frequently there are relatively thick mudstone, marlite, oil shale or pasty salt layers on the upper part of the coal measures or in the upper cap layers. They can serve as the cap layer of gas deposits of coal-formed gas.

The history of tectonic development of basins shows that our nation has some huge downthrown basins. They had sunk steadily over a long period, and later they did not undergo massive return. The coal seams of some coal containing basins are still buried very deeply even today. They can form large natural gas deposits. Many of the coal basins of the late Jurassic Epoch and the coal basins of the Tertiary did not undergo major tectonic changes and they are favorable to preserving coal-formed gas.

The coal fields of the Carboniferous-Permian Period in north China and some coal fields in the southwest have formed some complex anticlinal and synclinal tectonics or dome structures and brachy-axis anticlinal tectonics. They are favorable for trapping coal-formed gas. Ancient upwarping or syngenetic faults are also favorable to the concentration of coal-formed gas. In our nation's rich coal resources, coal of low-middle metamorphic stages consti[illegible] about 70 percent. In the process of coalification, they will surely produ[illegible] rich coal-formed gas.

This shows that our nation possesses favorable geological conditions for the genesis, deposition, capping and tectonic trapping of coal-formed gas.

1.1. The Distribution of Coal Mine Gas in China and the Indications of Natural Gas in Drilled Holes in Prospecting Coal Fields

The actual blowouts of gas in currently available mine shafts indicate that many mine shafts have a high content of methane and they are outstanding methane shafts. The distribution and the geological and tectonic zones of high methane shafts are clearly related. High methane mines are distributed in the Second Upwarping Zone of the New Huaxia System, the Yingshan Upwarping Fold Zone and its southern and northern edges, the Taihang Upwarping and Fold Zone and its eastern edge, the eastern edge of the Xuefeng (mountain) Upwarping, near the Qiyang Arc Fold Zone and the Nanling Fold Zone. The coal forming periods of high methane mines include almost all the main coal forming periods from the late Palaeozoic Era, the Mesozoic Era to the Tertiary Period. All grades of coal from lignite to anthracite are found, but they are mostly of the middle and high metamorphic stages. It is preliminarily believed that the mutual relationship among the three zones, the high methane mines, the middle-high metamorphic zones and the tectonic upwarping fold zones is characterized by a relatively shallow Mohorovicic discontinuity in these zones. The geotemperature gradient is relatively high because of the influence of violent tectonic movements and magma activity. They are mostly located in high geothermal fields. Coal fields in the upwarping and fold zones or their uprakes easily undergo second metamophisms (mostly thermal metamophisms) based on regional metamophism, causing the degree of metamorphism of coal to increase again. The coal-formed gas in relatively good deposits are massively adsorbed in the coal seams or concentrated in nearby rock strata.

Our nation has already extracted and utilized coal-formed gas in such coal mines as Fushun, Yangquan and Zhongliangshan. To a definite degree, they have solved production and safety problems and they can also provide civilian fuel for the inhabitants in the mining areas.

In the course of coal field prospecting, blowout of coal-formed gas from the drilled holes has occurred frequently. For example, blowouts of varying degrees have occurred while drilling in prospecting coal fields at such mines as Yangquan, Kailuan, Fuxin, Tieling and Zhangcunyi in northern Shaanxi, Zhijin Coal field in Guizhou, Liupanshui, and Yangjiashan in Hunan. Facts show that the coal containing geostrata in our nation and their underlying and covering geostrata contain coal-formed gas resources. In general, our nation's coal-formed gas has a bright future and we should prospect, evaluate, develop and utilize coal-formed gas.

At present, the extraction and utilization of coal-formed gas in our nation (especially gas in coal seams) are mainly carried out in the tunnels of mines that produce it. The United States has more commonly drilled holes from the ground surface to extract and utilize coal-formed gas in the shallow and deep layers. This is convenient. In the past, we only extracted and utilized

coal-formed gas in the adsorptive state in the coal seams below the mine shafts from the angle of production safety. We did not give much consideration to coal-formed gas that has moved into the geostrata of the coal measures or nearby wall rocks. To better prospect, evaluate, develop and utilize coal-formed gas resources in the future, we suggest that the basic theory of coal-formed gas and the study of the means of prospecting and testing, the method of evaluation and the techniques of exploitation and utilization should be strengthened and necessary advanced technologies should be imported. Special working groups should be organized and problems in allocating necessary funds should be solved. We should also make necessary readjustments in economic policy to mobilize the enthusiasm of the production departments.

9296
CSO: 4013/119

PROBLEMS CONCERNING THE DEVELOPMENT OF GAS IN COAL FIELDS

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 3, 25 Jun 82 pp 9-10, 18

[Article by Li Yingjin [2621 5391 0193] of the Fushun Research Institute of the Coal Sciences Research Institute]

[Text] In the process of mining coal, large amounts of associated combustible gases gush out. These gases mainly come from the coal seams and their wall rocks within the area of the coal fields that are being mined. The main content is methane. It is generally called mine shaft gas. According to estimates by some nations, the reserve of gas in coal even surpasses the reserve of natural gas. In the world, the total reserve of coal is 1,012.5 billion tons. Calculating according to the average content of gas in coal seams proposed by some nations, the reserve of gas in the world's coal seams can reach over 100,000 billion cubic meters. This is far larger than the reserve of natural gas (in 1979, the world's reserve of natural gas was 72,874 billion cubic meters). The total reserve of coal in our nation is 600 billion tons. Calculating at a gas content of 5 cubic meters per ton of coal and taking the gas coefficient of the wall rocks as 0.2, the nation's coal fields have a reserve of gas amounting to 3,600 billion cubic meters. It can be seen that gas in coal fields is an energy source that cannot be neglected and it should attract sufficient attention. But, the conditions of deposition and the methods of development of gas in coal fields are different from those of natural gas in natural gas fields. Therefore, clearly understanding the differences between gas in coal fields and fields of natural gas produced by coal and understanding the characteristics of development are necessary in rationally developing and utilizing gas.

1. Gas in Coal Fields and Fields of Natural Gas Produced by Coal

Since the 1960s, as research in the causes of oil and gas genesis and geochemistry continues to deepen, the theory that organic substances of plants can produce large amounts of natural gas in the process of coalification and can concentrate to become gas deposits has emerged. This theory has demonstrated a new future for the study of gas in coal fields and prospecting for natural gas.

Natural gas prospecting in our nation and abroad has shown that the use of the theory of the genesis of gas by coalification to guide natural gas prospecting has realized visible results. Huge natural gas deposits produced by metamorphism of coal measures have been discovered north of Urengkhovo in Siberia in the Soviet Union, in the eastern part of the Netherlands and in the southern basin of Beihai. The reserves constitute over one-fifth the total world reserve of natural gas. Gas deposits related to metamorphism of coal measures have also been discovered in our nation's southwest and northwest regions.

Foreign research in the material balance of coal formed by plants shows that the metamorphic process of coal can dissociate large amounts of gaseous hydrocarbons, mostly methane. In the course of forming 1 ton of lignite, 68 cubic meters of methane can be produced. The formation of 1 ton of fat coal can produce 230 cubic meters of methane. The formation of 1 ton of black jack can produce 330 cubic meters of methane, and in the course of forming 1 ton of anthracite, the total amount of gas produced can reach over 400 cubic meters.

Although the amount of combustible gases produced during the course of coal formation is very large, in the long course of geological history, these gases have undergone complex migrations and natural release. The content of gas presently held in the coal seams is only a part of the amount produced during the course of coal formation. The gases produced during the course of coal formation are distributed in the following ways: 1) gases held in coal seams; 2) gases that have migrated from the coal seams and have deposited in the wall rocks; 3) gases that have migrated from the coal seams and have dissolved in underground water; 4) gases that have been released into the atmosphere; 5) gases that have concentrated as gas deposits. Of these five, the first, second and fifth types of gases are significant for development. Although the cause of the formation of these three is the same, the forms of their reserves and the scale of their reserves are different.

Although the amount of gas held in the coal seams is large, but most of the gas is in an adsorptive state. When the conditions in the coal seams do not change, it is very difficult to release the gas. The gas accumulated in the wall rocks is generally small in scope and the amounts of the reserves are small. They are mostly localized. The gas of these two parts is the gas that has gushed out in the process of developing the coal fields today. For this, we call the gas held in the coal seams and the gas accumulated and deposited in the wall rocks as the gas in coal fields, and we call the concentrated gas deposits as fields of natural gas from coal. Such a differentiation has an important meaning in accurate prospecting, in estimating natural gas resources, and in rationally establishing plans for development.

III. Characteristics in the Development of Gas in Coal Fields

The major technical means of developing gas in coal fields at present is extracting and releasing the gas under negative pressure. The technical process is as follows: Holes are drilled in the gas containing coal seams or wall rocks in the tunnels at the bottom of the coal shafts. Pipes connect the holes with the gas pumping stations on the ground surface to pump the gas out. In general, this method is called pumping gas. The method of pumping gas is divided into the following according to the sources of the gas: pumping gas from mined coal seams, pumping gas from nearby coal seams and pumping gas from wall rocks. Pumping gas from mined coal seams is done when the coal seams have not been affected by mining. Because the aeration of the coal seams is low, most of the gas in the coal is in an adsorptive state, therefore, in general, pumping is more difficult. Pumping gas from nearby coal seams involves pumping the gas under conditions of unloading pressure during mining, and in general, better results are more easily realized. Pumping gas from wall rocks is localized pumping. At present, this method is used only in mine shafts with large deposits of gas in individual wall rocks.

In view of the methods of pumping gas described above, there are many differences between the development of gas in coal fields and the development of natural gas. They are mainly manifested as follows:

1. The Output of Gas From the Drilled Holes Is Small. In general, a hole of 100 meters long in contact with coal can produce 10 to 150 cubic meters/day of gas pumped from a coal seam without unloading pressure. And generally 500 to 5,000 cubic meters/day of gas can be pumped from a single hole in a nearby seam after unloading pressure. Compared to the output of gas from natural gas wells, this is obviously much smaller. Because the output of the single hole is low, and in order to pump a predetermined amount, more holes must be drilled. Sometimes, several dozen to several hundred holes have to be drilled in one pumping area.

2. The Pressure of the Gas Is Low. The pressure of the gas in the holes for pumping gas is relatively low. Generally the pressure of the gas released is below 3 atmospheric units. Because the pressure of the gas is low, we cannot rely on the automatic flow of gas to extract it. A vacuum pump is needed to pump it.

3. The Duration of Service of the Drilled Holes Is Short. The areas where holes are drilled to pump gas are all within the area of the mining shafts. When mining progresses into these areas, the pumping holes are immediately abandoned. In particular, the function of the holes for pumping the nearby coal seams serves concurrently during coal mining, and in general, they serve only about 1 month. Because the duration of service of the holes is short, and in order to keep the amount of gas pumped stable, successive holes must be continually arranged.

4. Pumping of Gas Is Limited by Coal Mining Conditions. At present, pumping gas is all done during the course of coal production. It has become a technological link in coal mining. Therefore, it is limited by the conditions of coal production and the conditions of the shaft. This situation limits the scope and the intensity of developing gas in coal fields.

III. Forecasting Future Development of Gas in Coal Fields in Our Nation

Because pumping gas can only be carried out during the course of developing coal fields and its scope and intensity are limited by the scope and the intensity of development of the coal field, therefore, these prerequisites cannot be abandoned when estimating the reserves of gas in the coal fields.

Reserves generally refer to the amount of natural resources that can be developed under actual technical conditions. The concept of the reserve of gas in coal fields should be the amount of gas that can be pumped within the area of development of the coal fields. This is called the exploitable amount of gas in coal fields. It is related to the intensity of mining and the amount of coal that can be pumped for gas as a proportion of the amount of coal mined. Through actual calculation, the exploitable amount of gas in coal fields is as follows: Within the next 10 years, the exploitable amount of gas in coal fields throughout the nation is 21 billion cubic meters, the annual average amount of gas that can be pumped is 2.1 billion cubic meters. Within the next 50 years, the exploitable amount of gas throughout the nation is 450 billion cubic meters, and the annual average amount of gas that can be pumped is 9 billion cubic meters.

In 1980, the total amount of gas pumped throughout our nation was 300 billion cubic meters (including the amounts pumped from abandoned shafts). In currently existing shafts that are being pumped, only 11 percent of the total number of shafts being pumped have produced the predetermined results in pumping. There are 43 percent of the shafts that are pumped irregularly and the results are not obvious. Another 46 percent of the shafts are in an intermediate state. In view of this, the potential for pumping currently existing shafts that are not being pumped is still very great. If all of these shafts can produce the predetermined results, the annual amount pumped can be increased by more than 120 million cubic meters. At present, the number of shafts being pumped for gas throughout the nation constitutes 34 percent of the total number of high gas shafts and outstanding shafts. It is estimated that by 1985, the number of shafts being pumped will increase by 9 percent. The annual amount of gas being pumped can increase by 25 million cubic meters. In this way, by 1985, the annual amount of gas pumped throughout the nation will be 450 million cubic meters.

IV. Several Suggestions

At present, the main purpose of pumping gas from coal mines is to guarantee safe production. The primary reason is prevention while utilization is secondary. In the future, efforts should be expanded on this basis to treat

... from coal fields as an energy source. For this, we should actively expand the scope of application of pumped gas and study technical ways to develop and utilize gas from the coal fields. According to the actual situation of coal production and pumping gas in our nation at present, the following suggestions are proposed for future work:

1. We should survey indications of gas in coal fields in geological prospecting and pump gas from wall rocks. In recent years, gas blowouts and relatively large gushes of gas have occurred in the rock tunnels at the bottom of shafts and holes drilled for geological prospecting in some mines. These phenomena have provided important clues in searching for fields of gas from coal and in expanding the development of gas in coal fields. In view of the situation that has already emerged, gas deposits in wall rocks are sizable sources of gas, and they may possibly become indications of fields of gas from coal. Therefore, we should investigate and study them in depth and actively pump them.

2. We should actively advocate the pumping of gas after mining. Large amounts of gas are usually accumulated and deposited in empty old mining shafts with a high content of gas and abandoned shafts. Although the gas no longer has any relationship to coal production, the shafts are still very good gas sources. They should attract our attention from the point of view of developing and utilizing gas. Shengli Coal Mine in Fushun is a coal pit that has ceased production and has been abandoned, but up to now, gas is still being pumped from it. The annual amount of gas pumped reaches 23 million cubic meters and it supplies gas to a formaldehyde plant and 6,635 families for use. According to foreign information, in 1976, Japan extracted 320 million cubic meters of gas throughout the nation. The amount of gas extracted from closed empty mining areas constituted 27.8 percent of the total. West Germany extracted a total of 555 million cubic meters of gas in 1979. The amount extracted from areas that had been mined was 182 million cubic meters, constituting 32.8 percent of the total. The development of pumping gas after mining not only can increase the amount of energy, it can also produce a relatively large economic result. Shengli Coal Mine in Fushun could still be used for pumping gas for 21 years after the shafts were abandoned. The total investment and expenditure for pumping gas for 21 years was 18.7 million yuan while the total income over the 21 years could reach 57.3 million yuan, earning a net profit of 38.6 million yuan. This amounts to an average annual profit of more than 1.8 million yuan. Summarizing the above, the development of pumping gas after mining is an effective measure to expand the development of gas in coal fields. This should be actively carried out in shafts of coal seams that do not easily ignite naturally.

3. We should launch studies in the techniques of utilizing low concentration gas. A part of the gas is released during the course of mining coal and the rest is blown away into the atmosphere. This amount of gas is very large. It is larger than the amount of gas extracted by more than 10 times. According to actual calculations, our nation releases more than 3.6 billion cubic meters

of gas into the atmosphere each year. Because of its low concentration, it cannot be utilized at present. Foreign nations are studying techniques to utilize this type of low concentration gas in recent years. The Soviet Union is studying measures to concentrate low concentration gas via many ways and relatively great progress has been realized. West Germany began to develop energy concentration devices for low concentration gas in mine shafts in the 1950s for generating electricity. If these techniques can reach the level of industrial application, they will open up a broad future for the development and utilization of gas in coal fields.

4. We Should Further Test and Study the Techniques of Drilling Holes on the Ground Surface to Pre-pump the Gas in the Coal Seams. Drilling holes on the ground surface to pre-pump gas in coal seams is an important technical measure to expand the development of gas in coal fields. It is not limited by mining conditions in the coal fields and the gas can be extracted beforehand.

9296
CSO: 4013/123

WAYS TO DEVELOP COAL ASH RESOURCES EXAMINED

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 7, 5 Jul 82 p 75

[Conference report: "Academic Discussion Meeting on Making Coal Ash Resources"]

[Text] The China Electrical Engineering Society and the China Environmental Sciences Society jointly held an academic discussion meeting in Kunming from the end of March to the beginning of April on making coal ash resources. A total of 148 delegates from concerned units throughout the nation attended the meeting. The conference received a total of 106 papers.

The content of this meeting was rich. It reflected the new situation, new achievements and new trends in the work of making coal ash resources in our nation in recent years. The meeting summarized the achievements of this work, the experience and existing problems, and explored ways to further develop coal ash resources.

The meeting indicated that the scope of utilization of coal ash in our nation is broad. For example, it has already been used in industrial and civilian construction, hydraulic engineering construction, road building and urban administrative construction, building materials, light industry, chemical industry, mining and agriculture. At the same time, a lot of research and exploration has been conducted in the basic theory of coal ash.

First, in building and building materials, such as the use of coal ash in concrete in hydraulic engineering construction, the average proportion of coal ash mixed in concrete in individual dams has reached 30 percent. This not only conserves cement, it also improves the properties of the concrete and improves the ability of the high and large dam to resist cracking. For 20 years, nearly 10 dams built with a mixture of coal ash have shown to be of good quality. The state has already established official standards for the use of coal ash as a mixture in cement. Low temperature synthetic coal ash cement consisting of coal ash as the main raw material is a new product that has been developed successfully in recent years. It has a large content of ash. Its demands on the raw material is low (both dry and wet ash will do). Its strength is strong from the beginning. It has a good future for development. Coal ash has also been widely used as the cushioning layer for roads and as a mixture in concrete and mortar for industrial and civilian construction. Coal ash silicate products have developed to large wall panels and air-filled concrete.

Second, many power plants studied systems of transporting dry ash and high concentration ash. Some power plants strengthened management of ash piles and used ash to cover the ground. This is an effective way to ease the competition for land between industry and agriculture. The experiment to use coal ash as a filler for coal shafts that have been emptied has conducted beneficial exploration in opening up underground ash piles for power plants, reducing collapses in mining areas, and protecting ground resources. The application of coal ash in agriculture has developed in 14 provinces and cities. It has developed from soil improvement, improvement of lowlands, covering winter wheat and paddy rice for seedling cultivation, producing compost to the use of coal ash silicon-calcium fertilizers and the application of magnetized coal ash. All localities that have used coal ash have realized different degrees of increased yields. At the same time, the question of the environmental impact of applying coal ash in the soil has been studied.

Third, in order to use coal as a resource, studies have been done in recent years to study its basic characteristics and theory and in separating the various components of coal ash. Through analytic research of coal ash by the nation's 146 coal-fired power plants, the relationship between the mineral content, the chemical content and coal burning conditions was found and an impirical formula for calculating the mineral composition has been proposed. Major factors affecting the activeness of coal ash under normal temperatures were studied. An impirical formula to predict the activeness of coal ash was summarized. This has provided a basis for better utilization of coal ash resources. Some power plants recovered iron and carbon from coal ash. This not only recovered useful resources, it also provided qualified products of ash for building materials. The coal ash beads developed in recent years can serve as a high grade filler for the military industry, the machinery industry, the chemical industry and light industry.

It can be seen from the above that the work of coal ash has already realized many achievements. But the rate of utilization is not high. According to statistics compiled at the end of 1980, the utilization rate is only 14 percent, not including the grounds filled by coal ash for coal ash piles. Compared to the rate of utilization of other nations, the difference is very great. The meeting analyzed the causes of existing problems, and proposed the following suggestions on this basis:

1. Propaganda on the use of coal ash as a resource should be strengthened via many methods, and the understanding of the work in making coal ash into a resource must be improved. Making coal ash into a resource should follow the policy of suiting measures to local circumstances and comprehensive utilization. It is suggested that the State Economic Commission, the State Planning Commission, the State Scientific and Technological Commission conduct uniformly coordinate the direction, planning, production management, scientific effort, popularization of new technology in making coal ash into a resource and gradually include the work of making coal ash a resource under the nation's resources management.

. In the work of making coal ash a resource, the state should have a corresponding policy of assistance. For example, the state should establish a price for coal ash products, a policy of favorable taxation, policies of rewarding those who use coal ash to conserve other resources, taking into consideration the state, the collective and the individual, and policies that limit the destruction of cultivated land to produce building materials.

3. In the work to make coal ash into a resource, we should hasten the basic study of the characteristics of coal ash and the separation and selection of the components so that coal ash will possess a superior quality and make breakthroughs in products, commercialization and in resources, to expand the scope of using coal ash.

4. Scientific research work in making coal ash a resource is technically weak. The means are relatively backward, therefore major scientific research projects must organize forces on all sides to study the problems together. At the same time, we must strengthen the exchange of information to cooperate with one heart and to hasten the progress in the work of making coal ash a resource.

9290
CSO: 4013/125

BRIEFS

XISHAN INCREASED COAL OUTPUT--The Xishan Mining Bureau of Shanxi Province has increased its raw coal production by an average of 1.03 million tons each year for the last 5 years. Output last year broke the 10-million-ton mark. Comparing January to June of this year with the same period last year, production increased by 610,000 tons, or 12.6 percent. Profits increased and primary economic and technical indicators have reached the advanced levels of similar enterprises in the country. Unit cost of raw coal production is the lowest among the country's large centrally equipped mines. The continued large-scale increase of coal production by bureau has been accomplished by existing mines. The original designed capacity of the four mines under the bureau was 4.05 million tons. In 1976, actual output was 4.84 million tons. In 1977 and 1978, output increased by an average of 1.30 million tons each year. [Excerpts] [Beijing RENMIN RIBAO in Chinese 19 Jul 82 p 2] 5974

CSO: 4013/136

OIL TO COAL CONVERSION--The boiler of a 125,000-kilowatt power generating unit of the Shanghai Wujing Thermoelectric Power Plant was recently converted from oil burning to coal burning. This was the first power generating unit in the country to change from oil burning to coal burning. A total of 160,000 tons of oil can be saved for the state annually. [Text] [Shanghai DIANSHIJIE [ELECTRICAL WORLD]in Chinese No 1, 1982 p 35] 5974

HEILONGJIANG COLLIERIES--Heilongjiang Provincial Collieries, whose products are distributed under the unified state plan, have achieved steady increases in raw coal output since readjustment 3 years ago. After readjustment, the annual production capacity of these collieries has increased from the original 22.35 million tons to the present 30.04 million tons, an increase of 34 percent. During the past 3 years, these collieries turned out a total of 100.51 million tons of raw coal, an increase of 19.46 million tons over that before the readjustment. In the first 7 months of 1982, these collieries produced an extra 1.08 million tons of raw coal compared to the corresponding 1981 peri[illegible] [SK241312 Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 23 Aug 82 SK]

CSO: 4013/108

ANHUI COAL CENTER--Hefei, 7 Jul (XINHUA)--Eight new mines with a combined annual production capacity of 15 million tons are to be opened for production between 1981 and 1988 at the Anhui Coal Center, one of China's largest. The center, which covers areas north and south of the Huai River in Anhui Province, is being expanded as a major step to increase the nation's output of coal, China's primary energy source. Construction of the 8 new mines calls for sinking of 30 shafts, of which 20 have been completed or are near completion, according to officials in charge of the expansion project. One mine, designed to produce 600,000 tons of coal a year, was put into operation last year, and another with an annual designed capacity of 1.2 million tons, will start production this year. [OW081005 Beijing XINHUA in English 1227 GMT 7 Jul 82 OW]

CSO: 4010/5

HOW TO USE NATION'S PREDICTED OUTPUT OF 100 MILLION TONS OF CRUDE PER YEAR IS SUBJECT OF SERIOUS CONCERN

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 3, 25 Jun 82 pp 13-15

[Article by Zheng Bingqiang [6774 4426 1730] of the Petroleum Design Institute of the Ministry of Petroleum Industry: "Improve Comprehensive Analysis, Use 100 Million Tons of Oil Economically"]

> [Text] Editor's Note: In the near-term, our nation's crude oil production will stabilize at 100 million tons. One million tons of petroleum is a huge amount of social wealth. At present, problems in the use, the management and the science and technology of one million tons of petroleum exist, and there is a lot of waste. Rationally utilizing this huge wealth can improve economic gain, increase income and improve the nation's economy. Rational use of this wealth requires a national energy policy, energy science and technology, energy management and a technical and economic analysis of energy. This magazine has launched a discussion on how to use this 100 million tons of petroleum well. We welcome the broad number of readers to actively submit articles expressing their own opinions and this magazine will select the best for publication as reference for those concerned.

For more than a decade, our nation's petroleum industry has developed rapidly and the achievements have been great, but because the management system is not scientific, the structure of consumption of petroleum is not rational, production techniques are backward, the results of comprehensive utilization are poor, there has been a serious waste of petroleum. To use 100 million tons of petroleum well, this article will present several shallow views with emphasis on the technical and economic problems in petroleum production, refining, storage and transportation and will discuss how to use the 100 million tons of petroleum well.

I. Lack of Scientific Management Causes Serious Waste of Petroleum

1. The structure of Consumption Is Irrational, the Amount of Oil Burned Is Too Large. At the beginning of the 1970's, as our nation's petroleum industry developed, proposals were made to change the fuel structure, to substitute oil

[illegible] and the amount of oil burned increased. During the 12 years from 1969 to 1980, a total of 300 million tons of oil was burned. Among this, 100 million was crude oil and 7 million was diesel oil. On the one hand, because the amount of oil burned was too large, the supply of crude oil for the refineries was insufficient and oil refining capabilities could not be fully developed, the consumption of unit product was large and the cost was high. Over the past 10 years and more, oil refineries engaged in light processing mainly for the production of heavy oil because too much effort was made to provide commercial heavy oil for fuel. On the other hand, not only were power stations with a capacity of more than 5 million kilowatts converted to oil-fired plants, a group of new oil-fired power plants was built, thus the proportion of petroleum in our nation's energy consumption structure increased rapidly. Calculating at international prices, the ratio of burning oil to burning coal showed that the loss of oil burned each year was very large. If petroleum resources were rationally utilized to gradually reduce the amount of burning oil, and if crude and heavy oil were supplied to the nation's refineries or exported to earn foreign exchange as capital for the development of energy and the construction of transportation and harbors, then such efforts could promote the smooth progress of building the four modernizations.

2. The Percentage of Loss in Each of the Links of Petroleum Production, Transportation, Refining and Marketing Is High. Although the petroleum industry is the sector that produces, processes, stores and transports energy, annual expenditure and loss are great. Six to 7 percent of every ton of petroleum is lost during the course of extracting the oil from the well to becoming processed petroleum products via production, transportation, refining and marketing. Adding the percentages of oil retained by the oilfields, pipelines and refineries for their own use, the loss will increase by onefold. Compared to foreign nations, this is much higher. Foreign nations use sealed pipes for centralized transporting of oil from the oilfields. The loss of oil and gas is 0.8 percent to 1 percent. At present, the comprehensive loss of oil in the oilfields in our nation is about 2.3 percent. Our nation's oilfields have begun to carry out technical improvements to reduce loss. If the loss can be reduced by 1 percent, this would be equivalent to an additional output of 1 million tons of crude oil. In addition, the percentage of loss at the refineries and the oil depots are also relatively high.

3. Trucks Consume Large Amounts of Oil, Light Oil Containers Lose a Lot of Oil. In the consumption structure of oil products, transportation consumes 20 percent, and of this amount, 60 percent is used by motor vehicles. The whole nation has 1.8 million trucks, and over half of them are Jiefang brand and Nanjing Yaojin brand trucks. The level of technology of these trucks is of the 1940's and 1950's. Compared to foreign trucks, fuel consumption per ton per 100 kilometers is 20 percent and 30 percent higher respectively. In addition, our nation does not have a large number of diesel powered vehicles. The Huanghe brand 8-ton vehicle is at the level of the 1950's. The fuel consumption per ton per 100 kilometers is 30 percent to 50 percent higher than that of imported diesel vehicles. If gas engines are gradually converted to diesel engines, and if some large tonnage diesel vehicles are developed, a large amount of oil products can be conserved each year.

The type of oil containers stored at the oilfields, refineries and commercial oil depots lacked frequent maintenance and management, and the respiratory valves of a large number of oil cans were frequently unused, instead, the caps were opened and a large amount of gasoline evaporated directly into the atmosphere. For example, an air tube of 3 cun long was installed on the large gasoline tanks of vehicles of a certain forest bureau of the Northeast region. Each day, about 150 kilometers equivalent of gasoline were lost. The Lanzhou Oil Refinery once estimated that the average daily loss of oil products from 30 light weight oil cans totaled 7 tons. If measures were taken to prevent loss, 70 percent to 85 percent could be recovered.

4. Site Selection Was Inappropriate, the Waste of Energy Is Large. In the past, the selection of oil depots emphasized being "near mountains, scattered, hidden." Therefore, the locations of some petrochemical plants, oil depots and gas stations were inappropriately selected. They were far away from transportation lines and from the users. The distance empty vehicles had to travel to the gas stations for fill-ups was long, or the distance between elevations was great. All of these caused frequent waste of motor energy. The elevation of the plant area was nearly 100 meters higher than the surface of the river. Also, the auxiliary facilities and residential areas of the plant were scattered. According to statistics, only 40 percent of the oil and gas resources consumed each year were used as raw materials by the chemical plant. The rest was consumed for power, or by the electric power station and for living. Also, for example, the oil depot of a certain plant near Changjiang was located at the lower reaches of the river in the city while the refinery was located at the upper reaches of the river in the city. Rows of overhead pipelines surrounded half the city. The back and forth transport of crude oil and finished oil products wasted energy.

5. Small Refineries and Large Refineries Compete for Raw Materials and This Has Affected the Economic Results

Our nation's oil refining industry has developed very rapidly during the recent decade and more, and now the processing capabilities of oil refineries are of a relatively large scale. Oil refineries are distributed throughout the nation. In recent years, because of the insufficient supply of crude oil, not all of the refining capabilities of the refineries could be developed. But small refineries are still being built blindly by some cities, counties and localities. This produces a greater waste of petroleum resources, the economic results are poor, and some petroleum products could not meet state standards. If half of the crude oil appropriated to the small oil refineries each year is transferred to large and medium sized oil refineries for processing, they can generate an additional profit of more than 100 million yuan compared to the small refineries.

6. The Production and Marketing System for Petroleum Is Irrational, There Is Duplicate Operations and Energy Is Wasted. The oil refining industry, oil depots, production and marketing require a lot of planning. Petroleum is also one of the products uniformly rationed by the state. But now, the oil refineries and marketing and sale of products of oil depots are under multiple leadership and scattered management. For example, a refinery is subordinate to the leadership of the province, the city's petrochemical departments and

...and several directories. In addition, commodity products of gasoline, kerosene and diesel oil are uniformly procured and sold by the Ministry of Commerce. Some subordinate oil depots are under the jurisdiction of several departments. For example, three oil depots built at one place and selling the same varieties of petroleum products are operated by three groups of people and each owns its own special railroad lines because one belongs to the commercial bureau, the other belongs to the forestry bureau and the third belongs to the agricultural reclamation bureau. Every time when the oil refinery dispatches less than 10 oil tank cars, locomotives have to be assigned to send the oil separately to 3 oil depots. Although the sales of petroleum are not large, the three oil depots have a relatively large number of oil tanks. The oil tanks cannot be filled and the loss of light oil due to evaporation over a long period is large. This situation is very difficult for realizing uniform dispatching. Split level management and repeated operations have created very unideal economic results for the refineries and the oil depots.

7. Crude Oil Is Uniformly Priced, Superior Quality Crude Oil Has Not Commanded the Economic Value It Should Have. Our nation has several dozen large and medium sized oilfields. The contents of crude oil and the quality are not entirely the same. Therefore, processing plans vary and the economic results are not the same. Now, some oil refineries are processing mixed crude. Some good quality crude oil and poor quality crude oil are mixed together in shipment and are refined as a mixture. Because the price of superior quality crude oil is the same as the price of ordinary crude oil, some special purpose crude oil have been used as ordinary crude oil and they have not commanded the economic value as superior quality crude.

II. Strengthen Comprehensive Analysis, Use 100 Million Tons of Petroleum Well

The above aspects only reflect the problems in the rational utilization of petroleum, the management system and energy distribution. They have created a large waste of petroleum and the economic results are poor. To improve comprehensive technical and economic analysis and use 100 million tons of petroleum well, the following views are presented:

1. We Must Have a Long-Term Stable Energy Policy. For more than 20 years, some industrially advanced nations have mainly relied on cheap petroleum from the Middle East and Africa to realize rapid growth of their own national economy. In 1973, the rise in petroleum prices forced them to slow their rate of economic growth or to find other countermeasures. Our nation is a socialist nation. We have plans to develop the national economy proportionally. There should be a stable policy for the development of energy and rational utilization. Looking back at the past dozen years or so, the economic loss due to the substitution of oil for coal and the overly large amounts of oil burned has been huge. At present, proposals to use hydroelectricity as a substitute for coal and oil have been presented. This is a more stable policy. But we must establish long-range plans for the development of petroleum and rational utilization, for example, technical policies to produce as much light grade oils and chemical raw materials as possible when refining petroleum. In general, it is urged that the nation can quickly establish a long-range, stable energy policy.

2. To Reduce Loss, We Must Strengthen Technical Improvements. In the past, we placed more emphasis on the technical improvement of certain technological processes. We paid attention to improving the quality of petroleum products, but we did not pay sufficient attention to the comprehensive technical improvement of the petroleum storage and transportation system. For example, the crude oil extracted from oil wells are placed in open containers in the open for long periods. The light grade oil fractions gradually evaporated, some oil products were lost, and the quality of the crude oil became heavy.

The concentrated transport of oil and gas in oilfields and in pipelines abroad is sealed. The residual pressure of the previous pumping station can continue to pump the oil in transport. We have used side oil tanks and measured the amount of oil products by the amount flowing into the tanks. To avoid malfunctions of the respiratory valves on crude oil tanks and light oil tanks in winter, the lids are opened and the loss of oil and gas is large. Therefore, the technical improvement of our nation's oilfields and pipes can conserve a lot of crude oil and light grade oils.

Floating cap tanks and inner floating cap tanks for crude oil and light grade oils have been widely utilized abroad. Loss due to evaporation can be reduced up to 95 percent. For example, a certain oil refinery in Beijing technically improved its 3,000-cubic meter gasoline tanks. In 1 year, measurements showed this reduced the loss by 180 to 200 tons. In 1 year, the loss thus saved could cover the entire cost of improvements.

3. Combine Petroleum and Chemistry, Rationally Utilize Oil and Gas Resources. The economic result of using crude oil or light oil to produce chemical raw materials is poor. The sources of raw materials to develop the petrochemical industry and chemical fibers in every nation must be combined with the characteristics of consumption of petroleum. For example, small automobiles in the United States consume a lot of gasoline. The scale of the oil refineries are relatively large, the degree of processing is deep, and gases from the refineries and natural gas are fully utilized as raw materials for the petrochemical industry. Western Europe and Japan have few petroleum and natural gas resources. The refineries carry out light processing mainly for the production of fuel. Their sources of raw materials for the petrochemical industry are mainly naphtha and light diesel oil. At the beginning of the 1960's, our nation once tried to use the gas from several oil refineries as raw material to build chemical fiber, chemical fertilizer and artificial rubber producing facilities according to the situation at the time. Definite economic results were realized. Later, as the output of crude oil increased and because the price of crude oil was low, comprehensive utilization of combined efforts in petroleum and chemistry gradually separated. Some chemical plants used crude oil as raw material. One ton of chemical fiber raw material required 10 tons of crude oil. Especially since the 1970's, some 20 sets of petrochemical facilities using mainly crude oil or light oil have been imported from abroad. Because raw materials could not be supplied, the facilities could not be operated at full capacity while large quantities of associated gases in the oilfields and gases from refineries were burned off.

[illegible], a petrochemical plant in the Northeast used 10,000 tons of ethylene gas each year to produce such chemical products as ethylene glycol. The production value reached 17 million yuan and the profits amounted to 2.8 million yuan. If crude oil and light oil were used as raw materials, the production value and profits would be much less. In the future, we should not only utilize gases produced by the oil refineries including liquefied gases as much as possible as raw materials for the chemical industry, we should also closely coordinate the oil refineries and the chemical plants and chemical fiber plants to conserve petroleum resources. We must combine our nation's situation to create a new way of developing a petrochemical industry that combines oil and gas and that can realize comprehensive utilization.

4. We Should Start Out From the Relationship Among Production, Transportation and Marketing To Rationally Adjust the Rationing of Crude Oil for the Oil Refineries and for Marketing and Sales Distribution of Oil Stored in Oil Depots. Under present conditions, we must investigate and study the regions that supply the nation's oil refineries and the amount of sales of the varieties of oil products needed by commercial oil depots in order to improve the distribution of oil refineries and oil depots of the petroleum industry so that the petroleum industry can realize greater economic gains and solve the weak link in the transportation of petroleum. The amount of crude oil to be processed by the various oil refineries and the varieties of products should be arranged according to sales plans and the relationship among production, transportation and marketing. At present, the oil refineries have a surplus processing capability and there is a greater leeway for choices.

To rationally utilize petroleum resources and the facilities of oil refineries better, we should carry out comprehensive optimization calculations for production, transportation, refining and marketing. We should include in one general computer program the cost of rationing crude oil to different oil refineries, the cost of the different processing methods in the course of refining (including combination of petroleum and chemistry, gains from comprehensive utilization) and the cost of transporting oil from the oil refineries to the various commercial oil depots and compute the optimal values, study the possible conflicts that may occur among the various factors and solve the problems by unified calculation for optimization.

5. We Should Readjust the Management System, Change the Method of Rewards for Energy Conservation so that Production, Refining, Transportation and Marketing Become One Continuous Line. At present, the petroleum management system is under multiple leadership. The refineries are under the leadership of several ministries and over a dozen provincial and municipal petrochemical bureaus. Marketing of petroleum products are conducted separately by many branches. In particular, there are many departments at the basic level units and this is unfavorable to implementing unified procurement and unified marketing of petroleum. We must gradually readjust the management system, reduce the number of intermediate links so that production, refining, transportation and marketing become one continuous line.

6. We Should Reduce Crude Oil Exports, Increase Exports of Petroleum Products and Chemical Products. It is always more beneficial for a nation that has an industrialized foundation to export processed products than raw materials and primary products. On the one hand, our nation's refineries have a surplus processing capability, and on the other hand, the more than 20 sets of chemical facilities imported several years ago cannot quickly develop their gain for the nation's economy because of a shortage of raw materials. But our nation has imported some chemical engineering products, chemical fibers and light industrial products. We can completely utilize our nation's own crude oil to produce more petrochemical and light textile products and gradually reduce crude oil exports, complete the building of imported chemical engineering facilities so that the refineries can provide even more chemical engineering raw materials, and at the same time, produce high grade petroleum products to strive towards producing more finished oils for export.

To use the 100 million tons of petroleum well, we must organize the scientific and technical personnel of concerned departments and strengthen technical and economic analysis of various aspects, plan scientific research well and gradually implement the results so that the 100 million tons of petroleum can produce ever greater benefits in building up the national economy.

9296
CSO: 4013/123

GUANGDONG: MORE SUCCESSES IN PROSPECTING FOR OFFSHORE OIL

HK061504 Guangzhou Guangdong Provincial Service in Mandarin 1000 GMT 5 Sep 82

[Text] There are rich oil and natural gas resources in the South China Sea. Rapid progress has been made in prospecting for off-shore oil reserves, and the prospect is really encouraging. Twenty-four off-shore drillings have been completed so far in the waters of the South China Sea, with drilling footage totaling about 70,000 meters. Geophysical prospecting has been carried out over an area of about 180,000 square kilometers and the data collected has been compiled. Thus, a firm foundation has been laid for the exploration of the South China Sea off-shore oilfield.

The South China Sea waters of our country cover an area of more than 2 million square kilometers. Back in the early 1960's, our country's oil exploration and geological departments had already carried out general surveys of oil and natural gas resources and magnetic surveys by air in certain water areas of the South China Sea. After these surveys, the departments concerned later carried out geophysical prospecting, discovered considerable oil-bearing areas and drilled a number of oil and gas wells having industrial value.

In light of the collected data, it is clear that the three main sedimentary basins in the northern part of the South China Sea have large oil-bearing areas. There are several dozen reservoir structures, each with an oil-bearing area exceeding 1,000 square kilometers.

In recent years, the South China Sea Off-Shore Oil Company, in promoting cooperative projects with foreign companies, has extensively made use of foreign funds and technology in speeding up the exploration of oil and natural gas resources in the South China Sea. The company has already entered into joint ventures with 40-odd companies from the United States, France and other countries, and completed repeated high-quality and high-precision seismic surveys over an area of more than 87,000 square kilometers on the continental shelf, which covers more than 319,000 square kilometers in the northern part of the South China Sea. The Sino-French cooperative prospecting project achieved even more prominent success: oil reserves worth exploring were discovered in different geological structures in the last 2 years.

CSO: 4013/164

DAQING GETS GOOD RESULTS FROM WATER INJECTION

OW1101624 Beijing XINHUA in English 1609 GMT 10 Sep 82

[Text] Daqing, September 10 (XINHUA)--Daqing--China's largest oilfield and the first to apply water flooding technique at an early stage--produced 34.7 million tons of crude oil from January to August, meeting 69.4 percent of the annual plan, according to experts attending the current international meeting on oilfield development techniques.

The oilfield has produced 50 million tons of crude oil in each of the past six consecutive years, thanks to the adoption of the technique of multizone exploitation of water flooding and other effective measures.

Since 1960, the experts said, Daqing has achieved high and stable production by applying the water flooding technique to its multizones to maintain reservoir pressure. Proceeding from the specific conditions in the water absorbing zones and the pay zones in the sandstone bodies, they said, the oilfield has conducted fracturing, water injection and exploitation of separate zones. These all have produced good results. By applying the technique of separate zone fracturing alone, the experts said, the oilfield is able to produce an additional 1 million to 1.5 million tons of crude oil annually.

To date, 11 of the production blocks put into operation earlier have produced more than 25 percent of the original oil in place. Of these, five blocks have produced more than 30 percent of the original oil in place. The whole oilfield is now producing oil steadily at a recovery rate of more than 2 percent, the experts said.

Daqing's high and stable oil production is expected to continue for a few more years, according to the experts. Daqing's successful experience has been introduced to other major oilfields in China, including Shengli, Jizhong, Liaohe, Dagang and Karamay.

At present, the experts said, 93 percent of China's annual oil output is produced by water flooding technique. The water injection technique is being applied to 90 percent of the country's oil in place.

CSO: 4010/3

SICHUAN SURPASSES MID-YEAR GOAL FOR OIL PRODUCTION

Chengdu SICHUAN RIBAO in Chinese 20 Jun 82 p 1

[Text] As part of the industrial renovation program to increase economic efficiency, the Sichuan Petroleum Bureau initiated an intensive effort in oil and gas exploration, and succeeded in meeting its production and construction targets. The mid-year goal of the national plan was achieved ahead of schedule in a number of categories: overall natural gas production, oil well drilling footage, crude oil production and refining, earthquake research, overall industrial production, as well as the production of graphite and drill bits. In addition, new drillings have yielded several oil and gas wells suitable for industrial use; and a new fracture system containing oil-gas structures and natural gas reserves was discovered, thus extending the areas for further exploration of natural gas resources in Sichuan.

Since the beginning of this year, the bureau has taken various measures to improve economic efficiency and to ensure the timely accomplishment of its production goals. First, they strengthened the management team to carry out a balanced program. Second, a policy of financial responsibility was established to properly associate responsibility with authority and reward. On the basis of practical considerations, each unit of the bureau carried out its own financial responsibility policy according to a format based on production and mission goals. Furthermore, special posts were created for the production, technological, and management aspects of the mission to refine the association of economic efficiency with financial responsibility and material reward. Third, an intensive effort was made to adopt new technologies and new methods. Fourth, activities to encourage personnel at all levels to work toward the goal of Four Modernizations were initiated. A wide variety of production contests were conducted by each unit of the bureau to achieve the goal of improved economic efficiency. Citations were given to high-performance units, model workers, and outstanding producers. A selected group of model workers and party members were invited to base-level units to tell their success stories in an effort to motivate local workers.

3012
CSO: 4013/122

PRC OIL DRILLING EQUIPMENT MEETS WORLD STANDARDS

OW130219 Beijing XINHUA in English 0203 GMT 13 Sep 82

[Text] Xian, September 13 (XINHUA)--A number of oil drilling machines and machine parts made by the Baoji Oil Drilling Machinery Plant now meet world standards, according to local authorities. Among them, the oil extracting machine and the hoisting ring have been assigned the right to use the mark "API" by the American Petroleum Institute.

l experts say that the oil extracting machine is novel in structure, with gh degree of precision, good sealing properties and operates at a low noise vel. It can withstand considerable loads. An American businessman placed n order for 450 the first time he saw the machine, the authorities said. A shipment of the first 150 was delivered at the end of 1980. A French businessman also considered the machine first rate and said he wished to be the second buyer of such machines.

The fatigue life of the hoisting ring is longer than those produced by other factories and conforms to the "API" standard.

he buckle gauge produced by Baoji plant has won an order for 22 specifications om the United States this year. The first 30 sets were delivered in the first arter of this year.

The plant also produced a world standard A-type drilling rig. A test in the plant shows that the rig is reliable, with a large loading capacity and long lifespan. This rig has filled a gap in China's 4,500-meter deep oil drilling and producing equipment.

Other products by the plant such as duplex metal cylinder sleeve, high-strength metric tap and turn arch gear were recognized as quality products by either the Ministry of Petroleum Industry or Shaanxi Province.

CSO: 4010/3

SOME PROBLEMS IN RECENT DEVELOPMENT IN GEOPHYSICAL PROSPECTING FOR PETROLEUM

Nanjing SHIYOU WUTAN [GEOPHYSICAL PROSPECTING FOR PETROLEUM] in Chinese Vol 21 No 2, Jun 82 pp 1-5

[Article by Chen Lusheng [7115 3337 3932] of the Jiangsu Command Headquarters for Petroleum Prospecting: "Several Problems in the Current Development of Geophysical Prospecting for Petroleum"]

[Text] [Abstract] This article analyzes the new situation and the new task facing geophysical prospecting for petroleum and the gap that currently exists. It emphasizes 10 problems that must be solved with great effort in the current development of geophysical prospecting for petroleum: 1) The planning; 2) digitization; 3) "three-in-one" seismic prospecting; 4) "the three links" together with emphasis on results; 5) data processing; 6) full utilization of old data; 7) development of new comprehensive methods of geophysical prospecting; 8) research; 9) technical equipment; 10) technical training. It also proposes some views and makes some suggestions concerning what technical policies should be taken regarding these problems, the measures for development and the solutions.

General survey and prospecting for petroleum has entered a new era at present. From the general survey point of view, the second round of general survey has already begun. The task during this period is to march towards new oil and gas fields, quickly find more petroleum reserves, discover more oil and gas bases so that the production of oil and gas can be gradually increased from the present level. This task is difficult. Our nation's long range resources of oil and gas are rich, but the geological conditions of such deposits and the geographic environment they are in are very complex. For example, we must change from seeking oil in continental facies which we are familiar with to seeking oil in marine facies, we must change from the Mesozoic and the Cainozoic which have not been greatly reformed and changed to the Mesozoic and Palaeozoic which are entirely different. We must change from seeking anticlinal traps to nonanticlinal traps, from the shallow parts to the deep parts, etc. The working environment will also enter deeply into large deserts rarely found in the world, loess plateau, the southwest mountain areas where transportation and construction are all extremely difficult. Geophysical prospecting for petroleum as a vanguard endeavor in the general survey for petroleum

will be the first to encounter such difficulties. It can be seen that the difficulty of the task of geophysical prospecting for petroleum has already reached the "world's advanced level." In technical strength, technical level and technical equipment, there is still a distance from the world's advanced level, for example, (1) data acquisition has not yet been completely digitized; (2) for a long time, attention was paid only to earthquakes and the methods were singular; (3) the processing method and the techniques are backward, at present, we are still in a stage of digesting what others have, and we have not yet formed our own system; (4) the level of comprehensive geological explanation is low; (5) advanced equipment is deficient, the accessories and supplies cannot form a system, in particular, the means of transportation are poor, and they are not suited to the requirements of the new task; (6) the three great links in seismic work are to varying degrees low in efficiency, poor in quality and they take a long period; (7) geophysical prospecting research is still in a stage of building a foundation, and it has not yet formed our nation's unique characteristics; (8) a technical backbone is lacking, and this has already seriously affected the development of geophysical prospecting for petroleum. Have we lost confidence because we have described the task to be a hard one and because we have presented so many problems? No. Starting from the tasks and the situation, analyzing the problems and the [illegible] countermeasures and measures. Obviously, in order for geophysical prospecting for petroleum to shoulder the task of the "vanguard" of the second round of general surveys for petroleum, we must concretely manage and reform our political ideology, business management, building teams, equipment and supplies, and technical work and such aspects. These problems are being considered by concerned sectors, but based on the spirit that "everyone is responsible for developing geophysical prospecting," some shallow opinions concerning several problems in technical policies and their direction in the current development of geophysical prospecting for petroleum are presented here as "reference" for others.

I. Planning

To start such a complex "machine" of geophysical prospecting for petroleum in a general fashion in a predetermined direction, we must have an overall plan. Therefore, organizing forces and drawing up development plans for geophysical prospecting for petroleum that are coordinated and matched with the various links corresponding to the second round of general surveys for petroleum are the current tasks at present. Whether we should emphasize the continued discovery of various types of traps and hydrocarbon abnormalities in the new oil and gas seeking areas as the central content of the plans and use these to ask other types of work and links to develop correspondingly in an organic manner is an extremely important task that must be frequently and repeatedly done. It is suggested that a planning office be established in the Geophysical Research Institute to take charge of organizing and drawing up various plans for geophysical prospecting for petroleum.

II. Digitization

Current geophysical prospecting for petroleum is most important in the general survey for petroleum because if the "vanguard" goes ahead alone, the troops

will not delay. The task faced by geophysical prospecting for petro- is an urgent need for digitization. Therefore, thinking of all ways to realize geophysical prospecting for petroleum should be the most important task in geophysical prospecting for petroleum. Whether this can be realized within 5 to 8 years is the key to grasping the initiative in the second round of general surveys for petroleum. Grasping digitization of geophysical prospecting for petroleum has already become a strategic problem. We should massively introduce digital mainframe seismographs that have already been tested for a long time while the accessories can be fitted domestically. We should also introduce a small number of more advanced instruments and then gradually advance toward using all domestically manufactured instruments. In digitization, the policy of first popularizing it and then improving it and combining domestic equipment with foreign equipment is correct. It saves time and it benefits the smooth launching of the second round of general surveys for petroleum and it will realize better results.

III. "Three-in-one" Seismological Prospecting

With the means of digital seismographs and computer processing, it is possible to carry out the three-in-one seismological prospecting of studying the tectonics, studying the lithological character of geostrata and directly seeking oil and gas. "Three-in-one" seismological prospecting will greatly advance the utilization of seismic data and the ability to solve geological problems, and the level of seismological prospecting will leap forward in quality. This is not only needed in the technological development of geophysical prospecting itself, it is needed more in the task of the second round of general surveys for petroleum. Should we establish a rule that all teams and regions that have digital seismographs should carry out "three-in-one" seismological prospecting? If we have digital seismographs but we still only draw a few tectonic diagrams, then like the analog seismograph, we will repeat the lesson of "using the analog seismograph as a high-grade seismograph." In implementing "three-in-one" seismological prospecting, we should propose corresponding requirements and rules for field work, data and interpretation. We can do this first in some regions to summarize experience and popularize it in time.

IV. Stressing the "Three Links," Together and Emphasizing Results

The three major links of data acquisition, data processing, interpretation of achievements in seismological prospecting are all very important and lacking one will not work. But the actual situation at present is that the leadership of the teams and the workers emphasize field data acquisition, the technical personnel emphasize computers and programming methods, and they neglect the interpretation of the results. In view of the two popular sayings that "the field is the foundation, processing is the key," interpretation has also been forgotten. We should say "interpretation of results is the gain" to make it complete. Blasting one ticket a thousand times and ten thousand times, data processing a thousand times and ten thousand times all serve to obtain good results. The results must be linked to achievements. If interpretative work is not done, it is very difficult to fully utilize the efforts of the two previous work procedures. The interpretation of achievements is the final manifestation of "a thousand days of toil and one day's harvest." Should we

[illegible] the principle of "simultaneously carrying out the work of the three [illegible]" and realize them in actual work. I suggest: (1) that we should hold comprehensive geological interpretation learning classes; (2) select typical areas to conduct comprehensive interpretation "battles" to summarize experience; (3) frequently hold meetings to exchange [illegible] in interpretative methods and experience; (4) establish and make [illegible] system for inspecting, reviewing and approving reports submitted on traps, pit positions and achievements; (5) establish achievement rewards for discovering traps; (6) improve the working condition for interpretation of [illegible]. [illegible] the forces of data interpretation.

V. [illegible]

At present, should we consider three aspects of work in data processing. First: [illegible] should quickly establish a work system and an enterprise system. It should solve the coordination between internal links so that they can fully work. It should solve the division of labor and cooperation between the central station and the local station. It should [illegible] and the long work [illegible] station's geological and ground surface [illegible] the results of the task of the second round of general survey [illegible], we should first perfect and utilize various types of (1) inverse convolution; (2) stationary correction; (3) deviation reset: (4) restoring true amplitude; (5) extracting and utilizing rate parameters [illegible] and technology. Third: We should fully utilize the advantages of the microprocessor, develop and popularize new field-based data instrument, solve the three problems of data acquisition, data processing, data interpretation that have been disconnected for a long period.

VI. [illegible] Utilizing Old Data

The [illegible] amount of information on heavy oil, magnetic ore, electric power, [illegible] still has a great function in evaluating the selected areas and [illegible] developing the potential for seeking oil and gas in the second round of [illegible] surveys for petroleum. We should utilize new methods, new theory, [illegible] to process and explain old data again. This is one of the [illegible] methods to hasten the general survey and to hasten the advancement of geophysical prospecting first. We must elevate the data and treat them as a work [illegible] that must be done first in the prospecting process when carrying out the second round of general surveys for petroleum. We must provide [illegible] funds, data processing, research projects, funds needed in utilizing old data in the plans and in planning. The geophysical research brigade has already gone one step ahead in studying old data. It is suggested that meet[illegible] to popularize their methods and experience.

VII. [illegible] New Methods of Geophysical Prospecting

[illegible] basic tasks facing us, we must develop comprehensively [illegible] methods of the most [illegible] oil, magnetic ore and electric power. The goal of developing new methods can be aimed at [illegible] directly looking for oil and gas; (2) studying [illegible] in detail, especially the problems that are difficult

[illegible] solving geological problems of deep [illegible]. It is [illegible] that the geophysical prospecting research center voluntarily shoulder this task.

VIII. Research

The research in geophysical prospecting for petroleum in presently available geological systems has grasped some techniques of developing geophysical prospecting methods that possess "growth points," that can solve the various types of geological problems and key problems that possess common characteristics, such as seismological lithology (including seismic geostratigraphy), and some problems in three-dimensional seismology and digitization. This is obviously correct and they should be studied with great effort. They are also the key projects for a definite period in the future. But, in view of the multiple overlapping method popularized during the 1970's and the second round of general surveys for petroleum in the 1980's, research in geophysical prospecting for petroleum is plagued by such problems as a weak strength and it has also exposed two major problems. One is that coordinated research projects needed to popularize research achievements that have a common characteristic cannot keep up. For example, the multiple overlapping method developed at the beginning of the 1970's was successfully utilized first in Jiangsu by the Sixth Geophysical Prospecting Bureau. But during its popularization, the study of the mountain area stationary connection and the bending line method was popularized relatively late, thus the mountain regions were able to develop the results of the multiple overlapping method very late. Stimulation is a major problem in regions of outcrop rocks. Systematic research is lacking, and in particular, the equipment was not renovated well and this hindered the use of the multiple overlapping method in these regions. In the regions with complex tectonics, the current deviation reset method is not ideal, and this has also limited the results of the multiple overlapping method. In the future, there will also be such problems. The second is that research in geophysical prospecting for petroleum has not solved the problems proposed at different periods and during different prospecting stages with foresight. This means, research work should walk in front and serve as a guide. We must solve the problem of timeliness corresponding to general survey work. For example, the second round of general surveys for petroleum has proposed marching towards the new realms to evaluate the selected areas. New methods, new technology to study old data and methods together with geology that can point out the regions for development are urgently needed. Finding new types of traps such as the lithological [illegible] of geostrata urgently needs a set of methods that can study the lithological character of geostrata and find traps in lithological geostrata. Marching toward the Mesozoic and the Palaeozoic will encounter old geostrata, high speed, large angle of inclination, and a set of new methods of interpretation and mapping that suit the old geostrata and such types of problems is urgently needed. Of course, some topics cannot be easily solved at once. We should allow research some time to work on it. But the problems described above that are present in the nature of regional coordination and the timeliness of the general survey must be conscientiously considered and solved in future arrangement of scientific research and planning. Otherwise, research achievements cannot be popularized in time. They easily form dislocated "production" and will even prevent geophysical prospecting from being carried out in general surveys. For this, should we use the principle that "the tasks follow the

[illegible], planning according to the region, the projects must be [illegible] by division of labor."

[illegible]. Technical Equipment

Technical equipment is a very big and outstanding problem in the current development of geophysical prospecting for petroleum. The methods at many localities are not up to standard. The efficiency of construction is low, the quality cannot be improved, and to a large degree, this is related to the lack of suitable technical equipment. The current situation in this regard is not good. There are few developmental personnel. The manufacturing time is long. Major instruments and equipment have relied on imports for a long time. Some auxiliary equipment and transportation equipment also have not yet formed a coordinated supply network. This seriously affects the development and advancement of geophysical prospecting for petroleum. It is suggested that the following problems be solved according to plan and step by step: (1) The teams with digital equipment should be equipped with complete corresponding accessory equipment so that they can fully develop their function (already being done); (2) We should establish and implement the accessory supply network for instruments and auxiliary equipment, materials that have been used up, means of transportation; (3) We should develop special equipment needed by various localities to do the task; (4) We should plan for the various types of equipment needed in future development and include this in the general plan, and the geophysical prospecting research center should also take research, planning and matching of technical equipment as its own task; (5) We should organize the "continuity" in the research, design, manufacturing and popularization of technical equipment for geophysical prospecting for petroleum.

5. Technical Training

The many problems and tasks mentioned above must finally be solved and done by people. Whether they are done well or not depends on the caliber and the enthusiasm of the people. Everyone will agree that of the 10 problems discussed here, technical training is the most important. In technical training, the most outstanding is the problem of training a technical backbone force. The present old backbone force is old. There is only a small number of new backbone forces and growth is slow. Development is not balanced. In the past, when we grasped training work, we did not pay sufficient attention to training backbone forces. We believed that the backbone forces are busy and cannot take time out to learn. There was a trend of "letting them live or die." If this is not solved well, there is the danger that other work cannot be launched. There are suggestions: (1) Old backbone forces must be given short term special [illegible] learning classes to learn new methods and new theory or supplementary [illegible] in a certain academic subject or opportunities to summarize experience [illegible] that there will be the time and opportunity to renew knowledge and to [illegible] and improve; (2) Talent must be selected to study instruments, computer software and hardware or certain special methods and techniques with medical tests so that such talent can continue to advance and thus train a group of experts. (3) Comprehensive talent such as people in charge of technology, technical management, comprehensive geological interpretation, research in comprehensive [illegible] and comprehensive planning must be trained well so that one division

in charge of technology, one interpreter and one person in charge of a small research topic. They must study all links and geological problems related to geophysical prospecting. They must draw up designs, plans, write reports, papers, summarize techniques, establish technical manuals, systems, and improve in actual work, and they should frequently set aside a fixed time for advanced studies. And with the method of having the old lead the newcomers, comprehensive talent will rapidly grow; (3) We must include technical training, especially the training of backbone forces in the general plan.

(This article was received on 28 December 1981)

TECTONIC FRAMEWORK, POSSIBILITIES OF OIL IN MESOZOIC ROCKS OF BOHAI BAY

Beijing SHIYOU XUEBAO [ACTA PETROLEI SINICA] in Chinese No 2, Apr 1982 pp 1-7

[Article by Hu Jianyi [5170 6015 5030], Tong Xiaoguang [4547 2556 0342], Xu Shubao [1776 2885 1405], Lin Dianzhong [5677 3013 1813] of the Petroleum Prospecting and Development Science Research Academy: "Geological Tectonics and Oil and Gas Possibilities in the Mesozoic Group of the Bohai Bay and Its Neighborhood"]

[Text] Abstract

The Mesozoic block in the Bohai Bay and its neighborhood are mainly controlled by the tension rift in the northwest direction. It can be divided into six large blocks. The article explains the formation of the blocks and the evolutionary characteristics. On this basis, the article further describes the petrogeological background producing oil and gas in the Mesozoic Era, and the presence of lucustrine deposits which have a definite ability of oil genesis and the presence of many types of trapping conditions where oil and gas reserves have been found. The Mesozoic Group may become a new system for prospecting oil and gas.

Foreword

The Bohai Bay and its neighborhood constitute the most important region of the Tertiary in our nation found to contain oil and gas. We have already conducted relatively in-depth research into the formation of the Tertiary System, related oil and gas fields and their patterns of distribution. Yet, the degree of prospecting and research in the Mesozoic Group covered by the Tertiary System is still very low. According to the distribution of petroleum and gas resources in the world, the reserves of oil and gas of this period constitute a relative superiority, undoubtedly, it is a target stratum that cannot be neglected. Up to now, positive indications of strata of oil genesis and many sites of prime oil and gas have been discovered in the Mesozoic Group, and it may become a new area of prospecting for oil and gas.

1. [illegible] Characteristics of the Mesozoic Era

The Mesozoic Era is the ending period of the developmental stage of the north China platform and the period of disintegration of platform blocks. It can be further divided into three stages of development and they correspondingly form three types of basins.

1. The Triassic Period. The north China platform underwent a lengthy period of platform development since the Sinian subera. By the late Permian epoch, complete regression occurred and the basin shrank. The Triassic System is a set of red clasolite deposits of the continental facies. Variation in the thickness of the geostrata is large. At some places, there are complete lucunnae mainly distributed in the southwestern region and a few are scattered in the northeastern region (Figure 1).

Figure 1. Distribution of the Tertiary in Bohai Bay and Its Neighborhood

According to the sections found in sinking wells in Liaocheng in Shandong and in Dingxi in Hebei, the Tertiary consists of geostrata of mainly purplish red and brownish red mudstone and light brown and grey lime sandstone with a thickness of 1,100 meters. The outcrop near Chengde is also a set of red clasolite with a thickness of about 1,600 meters.

At the end of the Tertiary Epoch, a series of multiple wide and gentle folds trending in the north-east strike formed on the background of the entire upwarping under the influence of the Indochina Movement. The Tertiary System was retained in the synclinal position. The Indochina Movement underwent a course of gradual change. Frequently, the fold of the older geostrata was tighter and the fold of the newer geostrata was wider and gentler. The intensity of movement also differed in different areas.

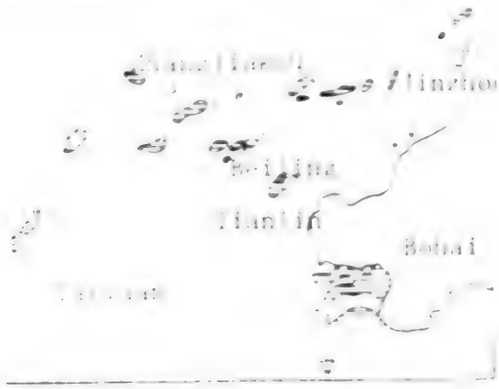
2. Early and Middle Jurassic Epoch. The tectonic movement in the eastern part of the north China platform gradually intensified under the influence of the Pacific plate and the hardened platform could not be easily regulated by plastic deformation. Violent block activity and magma activity began to emerge. In the early and middle Jurassic Epoch, the platform still possessed a transitional

...two middle and lower Jurassic Series formed and they spread towards east-northeast. The Yanliao area in the north has a total of 22 basins. Starting from the west in Wudong to Beipiao, the scale of all of the basins is small. The largest is not more than 1,000 square kilometers and the smaller ones span only several dozen square kilometers. The nature of the basins indicate that there are two types. One type consists of inherent tectonic synclinal basins in deceptive conformity contact with underlying geostrata and the scale of the basins is larger. The other type consists of intermountainous basins in unconformity contact with the underlying geostrata and the scale of the basins is smaller. The filling geostrata inside the basins are coal containing formations, volcanic rock formations and red colored mola rock formations (4333 ... 4258). The variations in lithological character and thickness are all very great. There are two sets of volcanic rocks. The Nandaling Formation of the bottom part consists mainly of basic rocks with neutral lava flow and volcanic clasolite sandwiched in between. The maximum thickness is 766 meters. The Tiaojishan Formation of the upper part consists mainly of basic rocks with acidic lava flow and volcanic clasolite sandwiched in between. The maximum thickness reaches 3,113 meters.

The middle and lower Jurassic Series in the southern part is mainly found in the ...ang Depression. The distribution is very broad. Depressions of the Tertiary ...stem are common but they are not discovered on top of protrusions. This may the result of denudation during later periods. The area of the initial basin ...estimated to have reached 25,000 square kilometers. It is the largest basin ... the middle and lower Jurassic Series in the eastern part of the north China platform. According to seismic and drilling data, the maximum thickness is estimated to be 3,000 meters, thicker than the neighboring outcropped region (such as Zhuangjin which is 295 meters thick) by more than a dozen times. But the lithological character of the geostrata and the fossils can still be contrasted. The lower part is the Fangzi Formation characterized by its content of coal. The ...sandy psephyte and mudstone form an interbedding which contains tuff and ...ffaceous sandstone and there are intrusions of lamprophyre veins. There are ...cycles, an upper cycle and a lower cycle. The coal beds are concentrated in ... lower part. The variations in lithological character and thickness are very ... For example, the thickness of the formation in the Zhuang 11 well is ...r 1,000 meters and it contains mainly sandy psephyte while the formation in ...ou'ba 31 well has a thickness of 200 meters consisting mainly of mudstone. The ...er part is the Santai Formation composed of purplish red, brownish red and ...lticolored sandy psephyte.

A ...t of geostrata about 500 meters thick has been encountered below the Cretaceous System when drilling the Hai 5 well north of the Chenning Upwarping. It ...sists mainly of tuffaceous sandy mudstone and sandy psephyte with a thin ...ite coal seam. It is rich in spore pollen fossils. It is estimated to ... the middle and lower Jurassic Series, therefore, its distribution may ... the southern part of the waters of Bohai.

The ...mmary Grain of the Qiuxian Depression in southwestern Hebei is very ...eloped. According to seismic profiles, it is an unconformity below the ... Series and it is in ... Cretaceous Series and it is in ... System. There is a ...



. Distribution of the Middle and Lower Jurassic Series in Bohai Bay and Its Neighborhood

ure 3. Distribution of the Upper Jurassic-Lower Cretaceous System in Bohai Bay and Its Neighborhood

The upper Jurassic-lower Cretaceous Series is distributed more commonly in the waters of Bohai. It is absent on only a few high protrusions. According to seismic data, the maximum thickness can reach 4,000 meters. This was discovered while drilling a number of wells. But its pattern of distribution and its geological tectonics are still not clearly understood. Preliminary analysis shows that there are two types of developmental regions, a southern region and a northern region. The upper Jurassic Series in the northern region is represented the Bozhong 7 well. It consists of volcanic rock series mainly of andesite and andesite volcanic breccia. The thickness is 558 meters. The lower Cretaceous Series is represented by the Bozhong 6 well and it consists mainly of grey and greyish green mudstone with a thin layer of calci-mudstone, a thin layer of limestone, dolomite and several layers of basalt and tuff sandwiched in between. The thickness is 340 meters.

The southern region is a set of volcanic clasolite. Its characteristics are similar to the Qingshan Formation in Shandong. It may be of the lower Cretaceous series.

The upper Jurassic Series-lower Cretaceous Series of the Huanghua Depression are small scattered basins. In the Dongguang area, the remnant area is only 300 square kilometers. The lower part is red clasolite and the upper part consists mainly of dark mudstone. According to the profiles of Gang 3 and Gang 4 wells, the lower part of the Qikou Depression is mainly andesite and basalt. The central part is sandy psephyte with dark mudstone. The upper part is dark mudstone with sandstone.

Upper Jurassic-Lower Cretaceous System in the Jizhong Depression re-
the Yan'l well in the Wuqing Depression contains basalt at the bottom.
the lower part is dark mudstone. The upper is purplish red mudstone. On the
south side of the Xushui fist is a set of dark purplish red clasolite. The
rates of fistrifaction are all very small.

total thickness of the upper Jurassic Series and Cretaceous Sys in the
Cangzhaizhang Depression is 4,000 meters. As revealed by Ji 2 well, the lower
part is porphyte of mixed color and basalt belonging to the upper Jurassic
series. The upper part is dark mudstone and marl mixed with greyish green and
purplish red mudstone belonging to the Cretaceous System.*

The upper Jurassic Series-lower Cretaceous Series in the Linqing Depressions,
according to seismic data, has a thickness of about 2,000 meters, separately
deposited in each of the depressions. The protrusions are lacunnae resulting
from deformation in later periods. Zixian Depression has 3 wells that reveal
the upper Jurassic Series, such as the Chaocan 1 well which shows red mudstone
mixed with greyish mudstone, sandstone and argillaceous dolomite. The depth of
the 4 well in the Qiuxian Depression is 2,533 to 3,200.5 meters (not penetrated).
drilling has encountered the upper Jurassic Series of interbedding of unequal
thickness of dark mudstone and pulverized sandstone. Drilling of three wells
in the Qingtai Depression has encountered the lower Cretaceous, such as the
Qian 1 well which showed a set of grey mudstone mixed with marl, oil shale and
pulverized sandstone.

The Nadaying Formation of the upper Jurassic Series distributed in western
Liaoning is not found in the Yiyang Depression but the Qingshan Formation of the
Cretaceous Series is broadly developed. It is mainly a neutral volcanic rock
series with a maximum thickness reaching 3,000 meters. It can be seen from this
that downbrown faulting began to occur in the Bohai Bay and its neighborhood in
the late Jurassic times, and the region received large area deposits.

.. Early Cretaceous epoch. At the end of the early Cretaceous Epoch, folding
and overthrust fault occurred again and lacunnae deposits occurred over large
areas. Only a few areas showed inherent development with the lower Cretaceous
exposed such as the Wuji Prefecture at Shijiazhuang.

II. Characteristics of the Blocks of the Upper Jurassic-Lower Cretaceous Series

The upper Jurassic-lower Cretaceous Series at Bohai Bay and its neighborhood
showed visible block tectonics. Its main part (i.e., except the Liaohe
depression and Liaodong Bay) is controlled mainly by the northwest rift. But because
it was intermed by violent shearing of block movements in the northeast strike
in the Eocene Epoch and the Oligocene Epoch, the northwest rift became
discontinuously distributed, and at some regions, the forms are more ambiguous.

*Editor's note to Yang Shuchun [0481 2579 1431] et al: Discussion of the spore
pollen formation of the [illegible] Cretaceous in the Wuji Prefecture in Hebei.

[illegible] Rift and the Hengshui Rift are the main rifts that control the upper [illegible] of the upper Jurassic Series-lower Cretaceous Series in the southwestern part of the basin. Daming Rift has a northwest strike. It slants towards the northeast and extends for over 80 kilometers. The Hengshui Rift has a northwest strike and slants towards the southwest. In the Jizhong Depression, it is about 120 kilometers long. It may possibly surpass the Changxian Upwarping and may connect with the plain rift on the southwest edge of the Chengning Upwarping. The northwest rift in the central part of the basin of Bohai Bay is also very developed. There are four rifts on the line of strike from Xushui to Guangrao. They all slant towards the southwest. The Xushui Rift, the Hejian Rift, the Baibuo Rift, the Guangrao Rift are respectively 40, 14, 80, 30 kilometers long. There are three rifts on the line of strike from Tanggu to Chengbei. They also slant towards the south. The Tanggu Rift, Shaxinan Rift and the rift on the southern edge of the Chengbei Protrusion are respectively 25, 35 and 60 kilometers long. There are also three rifts slanting towards the southwest on the line of strike from Yanggezhuang to the northern part of Bonan. The Yanggezhuang Rift, the Shadong Rift and the rift on the northern side of Bonan are respectively 20, 30 and 60 kilometers long. Also, there are some scattered rifts in the northwest strike and they slant towards the southwest, such as the Qingnan Rift, the Qingnan Rift and the Bonan Rift which are respectively about 80, 30 [illegible] kilometers long.

[illegible] rifts in the northwest strike that slant towards the southwest on the Luxi Upwarping are also very developed. The longest is the Feicheng-Linqi Rift which extends 200 kilometers. The Xintai-Duozhuang Rift is over 60 kilometers long. The Tongvedian-Caizhuang Rift is over 30 kilometers long.

All of the northwest rifts described above except the Daming Rift slant towards the northeast. All other rifts slant towards the southwest. Therefore, the downthrown faults they control are mostly all large dustpan shaped downthrown faults except Linqing which is a symmetric graben type downthrown fault.

[illegible] geotectonics of the upper Jurassic Epoch-lower Cretaceous Epoch of the northeastern part of the Bohai Bay region, the narrow and long Liaodong Bay and the Liaohe Depression are mainly controlled by the northeast rifts. The Liaoxi Rift [illegible] Liaodong Bay and the rifts on both sides of the Liaodong Protrusion are all [illegible] kilometers long. The rift on the east side of the Liaodong Protrusion slants towards the east while the other two rifts all slant towards the west. The Liaosheng-Huanxiling Rift of Liaohe is nearly 200 kilometers long and it also slants towards the northwest. These rifts control the formation of the narrow and long dustpan shaped downthrown fault of the upper Jurassic-lower Cretaceous series. The Liaohe Depression also has rifts in the northwest strike. Their scale and function are smaller. For example, on the foundation of the general [illegible] of the Zhangwu-Panshan downthrown fault in the northeast direction is a [illegible] of northwest rifts of lengths not longer than [illegible] They further separate into alternating concave and convex tectonics.

In general, the block movement of the late Jurassic-early Cretaceous [illegible] of the entire basin of Bohai Bay with the northwest rifts as boundaries into [illegible] tectonic blocks. They are from south to north, the Neimuang, Dongpi Block, the Linqing Block, the Raoyang, Huimin Block, the Guan, Huangnan, Dongying Block, the Binghai Block, and Liaodong Bay, Liaobei Block. (Figure 3)

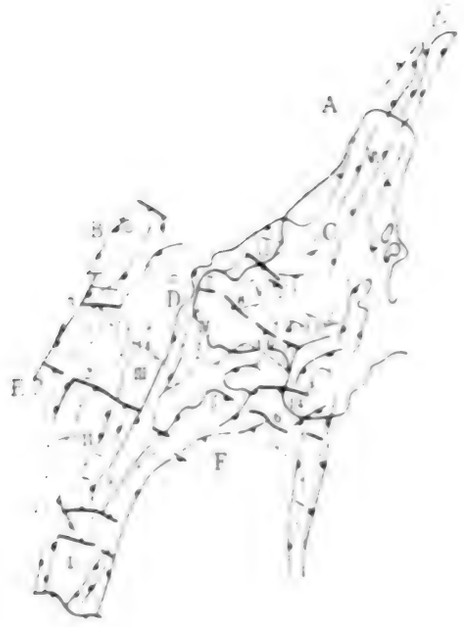


Figure 4. Division of Mesozoic Blocks in the Bohai Bay Area

Key:

A. Jinzhou
B. Beijing
C. Bohai
D. Tianjin
E. Shijiazhuang
F. Jinan

I. Neihuang, Dongpu Block
II. Linqing Block
III. Raoyang, Huimin Block
IV. Gu'an, Huanghua, Dongying Block
V. Baizhong Block
VI. Liaodong Bay, Liaoxi Block

1. Daming Rift
2. Hengshui Rift
3. Xushui Rift
4. Hejian Rift
5. Huimin Rift
6. Guangrao Rift
7. Tanggu Rift
8. Shaxinan Rift
9. Rift on the southern edge of the Chengbei Protrusion
10. Yanggezhuang Rift
11. Shadong Rift
12. Rift on the north side of Bonan
13. Chengnan Rift
14. Qingnan Rift
15. Bonan Rift

can generally be divided into the graben type and the horst type. ... absence or thickness of deposits of the Meso- ... for example, the Nanpiang, Dongge Block and the Fanyang, Huimin ... are in a relative uplift upwarping state. Most of the areas of the depos- ... of the Mesozoic Group are lacunnae or have only thinner and scattered ... The substrata in the western part of the blocks are mostly lacunnae ... and they gradually accept deposits eastward up to the present area of water ... the thickness correspondingly becomes thinner. Conversely, the Linqing ... of the Jin'an, Huangxian, and Dongying blocks show a graben state. They ... all, the major regions of distribution of the Mesozoic Group and they are ... According to the epitectonic characteristics of the upper Jurassic- ... lower Cretaceous series and analysis of the sedimentary substrata based on geo- ... logical and geophysical data, we can generally determine the distribution of the ... substrata of the Mesozoic Group and the scale of deposition.

III. Exploring the Prospects of Oil and Gas of the Mesozoic Group

1. Discovery and Proof of the Existence of Lacustrine Deposits

... of Bohai Bay and its neighborhood are in the peak ... of their activity. The differential activities of rising and falling ... have produced a series of downthrown faults of the Mesozoic Era. A set ... of sandy psephyte formations, volcanic rock formations, coal containing forma- ... tions and oil shale formations has accumulated in these downthrown faults and ... the formations make up a set of complete sedimentary cycles. The lower part ... consists of volcanic rock formations and red sandy psephyte formations while ... the upper part consists of coal containing formations, oil shale formations ... and dark basalite formations. The characteristics of deposition shows a pro- ... gression from coarse rocks to fine rocks and from red to dark, and the environ- ... ments of deposition reflect a change from oxidation to reduction, from high ... filling to relatively persistent and stable deposition. Therefore, the ... upper part of the upper Jurassic-lower Cretaceous Series is a set of shallow- ... water lacustrine deposits composed of dark grey and grey mudstone, and oil ... shale with thin sandwiched layers of dolomite and sandstone. The horizontal ... laminations and fine stratifications are relatively developed. A lot of ... fossil fragments, coal slack, coal seams and coal beds are seen. They are also ... rich in mussel-shrimp and charophyte fossils. The environments of deposition ... are mainly semi-deep strata of reduction and weak reduction. The general ... content of bivalent sulfur is 0.11-1.05 percent, the reduction coefficient of ... organic matter is 0.4-0.6, and there is a definite ability for oil genesis. Two reser- ... voirs of oil genesis have been proven by drilling and prospecting to exist: ... one consists strata in the coal containing rock series in the upper part of ... the Jurassic Series and an oil genesis stratum of the shallow-deeper ... lacustrine facies in the Cretaceous System.

... the Downthrown Fault ... [illegible] ... Downthrown ... [illegible] ... a shallow lacustrine and deltaic ... [illegible]

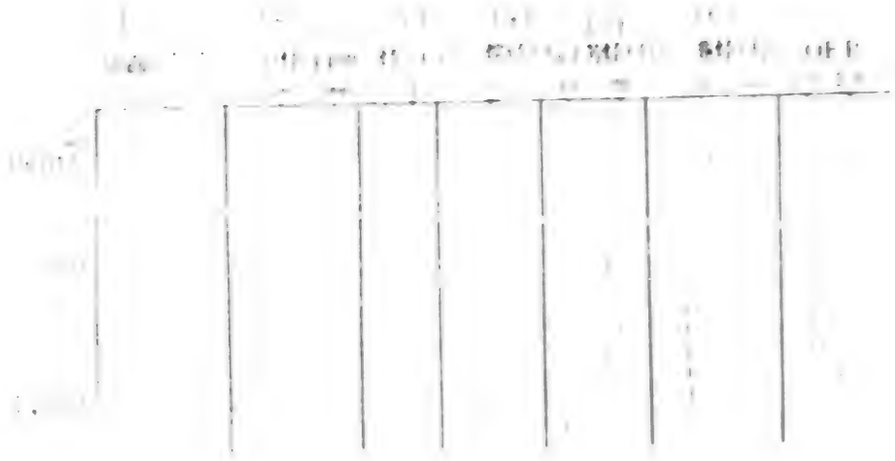
Summary of the Conditions of Oil Genesis of the Mesozoic Group in the Basin of Bohai Bay

(1) 构造单元	(6) 层位	(11) 暗色泥岩厚度(米)	(12) 有机质丰度指标 (13) "A" (ppm)	总烃 (14) (ppm)	有机碳 (15) (%)	(16) 正构烷烃 (17) 生油岩 OEP	(18) 主峰碳	(19) 原油 OEP	(20) 主峰碳
(2) (省名)凹陷	(7) 白垩系	580	1056	937	1.12	1.08～0.98	C_{19}	1.10	C_{19}
(3) 北(地名)凸	(8) 上侏罗统～白垩系	1200(?)	649	554	1.84	1.17～1.2	C_{29}		
(4) 秦南凹陷	(9) 白垩系	2300	1507	600	0.80	0.89	C_{16}	0.94	C_{15}
(5) 东营、油页岩段	(10) 上侏罗统梨树沟组	500	1383	594	2.76	1.09～1.02			

(21) 注：(据有关油田分析资料)。

Key:

(1) Tectonic unit
(2) Shijiazhuang Depression
(3) Beijing Graben
(4) Qinnan Depression
(5) Sujiacun, Youyangou Downthrown Fault
(6) Stratigraphic position
(7) Cretaceous System
(8) Upper Jurassic Series-Cretaceous System
(9) Cretaceous System
(10) Lishugou Formation of the upper Jurassic Series
(11) Thickness of dark mudstone (meter)
(12) Indicators of abundance of organic matter
(13) Chloroform asphalt "A" (ppm)
(14) Whole hydrocarbons (ppm)
(15) Organic carbon (percent)
(16) Normal alkanes
(17) Oil genesis rocks
(18) Peak carbon
(19) Crude oil
(20) Peak carbon
(21) Note: (According to analytical data of related oilfields)



Maturity [illegible] of organic substances of the Jurassic System in [illegible] well in the Eastern Depression at Liaohe
(Supplied by the Liaohe Petroleum Prospecting Bureau)

(1) [illegible] (percent) (4) Alkanes (percent)
(2) [illegible] (5) Aromatic hydrocarbons (percent)
(3) [illegible] (6) Nonhydrocarbons (percent)

[illegible] indications of oil and gas and seepages of oil were seen to be closely related to the [illegible] of oil genesis of the Mesozoic Group. For example, [illegible] basin is a basin of the Jurassic System not covered by the Tertiary System. Indications of oil and gas have been widely seen. Oil flow has been obtained from oil [illegible] of the Shahai Formation in the Dongpanz Tectonic and [illegible] Depression of the Liaohe Petroleum Basin. Jiaolai Basin is also a basin of the [illegible] not covered by the Tertiary System. Asphalt veins have been seen [illegible] to the Mesozoic Group and / strata of oil-bearing sandstone have been encountered in the Laiyang Formation where the Sanfoliqiao Tectonics of the [illegible] are not in contact with the oil genetic strata of the [illegible] Group. [illegible] show that oil undoubtedly comes from the oil [illegible] of the Mesozoic Group.

[illegible] oil has [illegible] to the prevalence of volcanic rock [illegible] Depression and the Subei Basin [illegible] Comparisons of the oil content show that [illegible] of normal alkanes of crude oil are all not [illegible] [illegible] relationship is rather close [illegible]

[illegible] of oil containing areas with the Mesozoic [illegible] oil has already been discovered at present. [illegible] [illegible] Series of the Mesozoic [illegible] due to the wealth of [illegible] oil in dolomitic sandstone and

...Yibei in the Zhanhe depression have been ...
...of the Jurassic System have been ...
...ge exploration potentials. The Mesozoic strata have good depositional ...
...ly favorable trapping condition.

...ozoic Group are not developed. They are mainly ...
..., tuffaceous rocks and crevasses and pores mainly in the intrusive ...
... The traps of oil deposits in mainly the volcanic rock series of the ...
...ng depression in the Shiguidun upwarping zone are mainly distributed ...
...ic rocks at the Tertiary. After a long period of weathering ...
...ctonic stress, andesite volcanic breccia, andesite volcanic ...
...ous acidic lava respectively produced pores, crevasses ...
...between secondary clastic rocks, thus forming good depository ...
...ty of oil tests prove that high yields can be obtained and they ...
...ulation of strata of oil deposits. The depository mechanism ...
...ter. According to analytical data of the physical ...
...ristics of the oil strata of the Jurassic Series in the Yuxin basin, ...
...ween the depository properties is relatively large. The deposits are ...
...ls are more high. The one in Shanxi-2 well is ... to permeability ...
...ty is from 1.0 to 50 darcy. But the physical properties of the ...
...ata of some wells are poorer. The porosity is generally ...
...nt and the permeability is only 1 to 5 millicarcy. Because there is ...
...ficient information on the physical properties, the pattern of variation ...
...ll not clearly understood.

...ording to tectonic characteristics of the Mesozoic Group and the characteristics ...
...sedimentation and the position during the course of its evolution, it is ...
...ticipated that there are the following types of oil and gas deposits: unconformity ...
...oil deposits overlaid by blocks of volcanic rock, oil deposits in compressed ...
...structural tectonics, oil deposits in blocks, and oil deposits in unconformity ...
...ion of substrate and lithological oil deposits.

...ozoic tectonic in the waters of Bohai is an uncon... ...
...ly overlaid by a block of volcanic rock as a cap layer. The ...
...ic Group is situated in the southeastern part of the Shiguidun upwarping ...
...ion of the Zhanhua Depression. It is a buried block sandwiched ...
...by two east-west faults. The argillaceous cap layer of the Shahejie ...
...ge of the Lower System System directly overlies the volcanic rock of ...
...ic Group as an unconformity, forming an unconformity trap. ...
...the buried hill volcanic rock of the Mesozoic Group. Oil and gas ...
...which formed the commercial rock strike at the lower Cretaceous Series of the ...
...ion of the Shahejie Formation. The oil bearing rock has been ...
...ities and mostly of unconformity faces or faults in the depository chain of ...
...ion for the oil and gas deposits. The distribution of oil and gas is ...
...ed by the trapping. The oil ... ...
...ly ... oil ...

Figure 7. Illustration of the Section at Oil Deposits in the Mesozoic Group at Yibel

[illegible], such as the Turpan Depression in the Lingjing Depression, the [illegible] Depression in Qinghai especially the pastures south of the Eastern [illegible], the Turpan Basin, the Jiaolai Basin and the valley of Mesozoic [illegible] in front of Taihangshan.

(The article was received on 31 March 1981)

[illegible] (XINHUA)--China produced [illegible] million [illegible], fulfilling the semi-annual production plan [illegible] ahead of schedule, according to the Ministry of Petroleum Industry. In the first [illegible] months of 1981, the country's crude oil output was up [illegible] percent over [illegible] and the total value of petroleum output [illegible] percent. [illegible] turned over to the state and taxes paid by the petroleum industry [illegible] percent, while the cost for drilling 1 meter dropped [illegible] percent. [illegible] production plans were overfulfilled ahead of schedule by the [illegible] oilfields including Daqing, Jilin, Liaohe, North China, [illegible] Yumen and [illegible] as well as the Sichuan oil and [illegible] field. [illegible] [OW[illegible] Beijing XINHUA in English [illegible] GMT [illegible]]

[illegible]--Prospecting since last year has uncovered [illegible] sites [illegible] of the country with oil reserves which offer good prospects for [illegible], according to the Ministry of Petroleum Industry. They were [illegible] potential localities. Last year prospectors [illegible] experimental [illegible]. Oil production in [illegible]. Since 1949, it has risen [illegible] million tons in 197[illegible], according to the ministry. [illegible] oil and gas fields have been set up for production in 1[illegible] provinces, [illegible] and autonomous regions. [HK240402 Beijing CHINA DAILY in [illegible]]

CHINA NATURAL GAS--On 5 September, the Bureau of Oceanographic and Geological Survey held a meeting at the Shanghai People's Government Auditorium to mark [illegible] completion of the Longer [7893 0059] well, to summarize the experience and [illegible] personnel for outstanding performances. The drilling of Longer well [illegible] prospecting in the East China Sea started on 1[illegible] March this year. [illegible] well was completed on [illegible] July and began to produce natural gas on 4 August. [illegible] of this well has provided valuable information on geological survey [illegible] the continental shelf of the East China Sea. It is a fresh breakthrough [illegible] prospecting in this sea area. [OW231141 Shanghai WEN HUI BAO in [illegible] Sep [illegible]]

[illegible]--According to Ye Jiazhen[illegible], deputy leader and chief engineer [illegible] geological survey team of Shanghai's Oceanographic Geological [illegible] Bureau, [illegible] offshore oil prospecting well was successfully [illegible] in the East China Sea on the eve of the opening of 12th National CPC Congress. At present, it is China's deepest offshore well. It was also the first time that natural gas was detected in the East Sea. [OW24[illegible] Shanghai [illegible] in Mandarin 1100 GMT 1[illegible] Sep 82 OW]

[illegible]--Nanning, 1[illegible] Jun (GUANGXI RIBAO)--The [illegible] has been completed and [illegible] on 21 June. [illegible] first [illegible]

[illegible]

[illegible]'S POTENTIAL FOR TIDAL POWER

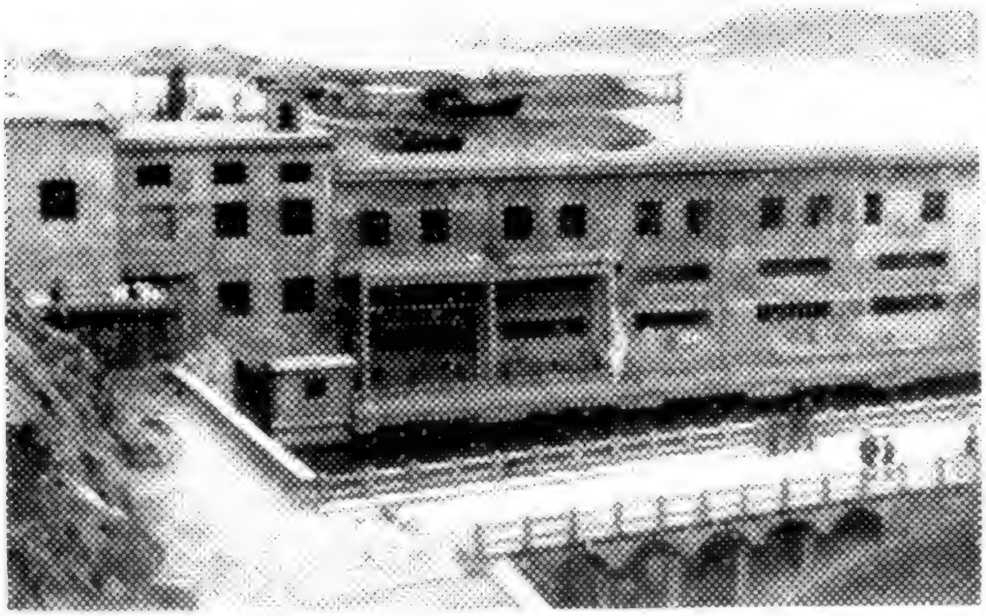
[illegible] ZHEJIANG RIBAO in Chinese 8 Jun 82 p 4

[Article by Chen Yafei [7115 0068 7378] of the East China Surveying and Design Academy of the Water Conservancy and Electric Power Ministry: "Bright Future for Tidal Power Generation"]

[illegible] province is located along the sea coast. The coastline is more than [illegible] kilometers. Tidal resources are rich. The maximum tidal drop of Qiantangjiang reaches 8.9 meters, and the average tidal drop is 4.3 meters. According to statistics, the exploitable installed capacity of electricity generated by tidal power in our province constitutes 40 percent of the total capacity of electricity that can be generated by tidal power throughout the nation. On the other hand, our province lacks ordinary energy resources. There is a shortage of electricity for industrial and agricultural use. The percentage of self-sufficiency in energy sources is low. Most of the energy relies on other provinces. Therefore, fully utilizing tidal resources at home to generate electricity is an effective measure to solve the shortage of energy in the province. It also coincides with the principle of "suiting measures to local circumstances, mutual compensation when there is more energy, comprehensive utilization, pay attention to practical results" in the development of sources of electricity.

[illegible] the natural cyclic rise and fall of seawater produced by the gravitational pull by the sun and moon. This activity contains a large amount of [illegible] energy. The use of this type of energy to generate electricity [illegible] mechanical facilities is tidal power generation.

[illegible] are many advantages in the use of tides to generate electricity. Compared to ordinary hydroelectric power, it is not affected by meteorological [illegible] hydrological conditions. The source of water is reliable, regular and predictable. It does not cause loss in flooding farmland. The population in the [illegible] area need not be moved. It does not destroy the ecological balance [illegible] aquatic life. It can also be combined with other facilities to generate electricity [illegible]. It can develop comprehensive utilization, such as aquatic products, and plant can be planted on the encircled and reclaimed land. Compared to [illegible] or atomic energy for the generation of electricity, it does not pollute and it does not need additional [illegible] application [illegible].



[illegible]

The manufacturing and use of firewood conserving stoves are not complicated. When conscientiously popularized, the use of such stoves would greatly increase the supply of energy without compensation.

Develop Firewood Forests in a Big Way

The severe reality at present is that each year, the actual amount of firewood felled is 3 to 4 times the amount of firewood that can be normally supplied by firewood forests and other types of forests. Overly felling will cause many green mountains to become barren mountains. Without green mountains, where would the firewood come from?

The way to increase firewood is to plant more firewood forests. The key in developing firewood forests should be to plant them in hilly regions and plains. All land that can be planted with trees and grass should be fully utilized. There are more people and less land in plains but the potential in greening the empty spaces of the "four sides" cannot be neglected. Our nation now has 1.83 billion mu of forests, but the percentage of coverage is only 12.7 percent. There are 1.17 billion mu of wasteland suitable for forestation. If by the year 2000, forest coverage throughout the nation can reach 20 percent, then the forested land should increase to 2.9 billion mu. Now, the enthusiasm of forestation and planting trees has begun throughout the nation. We should guarantee that every tree planted lives. This not only can provide firewood, it can also basically improve ecological conditions. Japan is far-sighted. Even though its population density is greater than that in China, but it pays a lot of attention to forestation and the expansion of forests. During the more than 30 years after the war, Japan's forest coverage increased from 47 percent to 68 percent. This is worth learning.

Another way to increase firewood is to strengthen intensive management at present and improve the level of production in forest land. In advanced nations, each hectare of forest land has an accumulation as high as 200 cubic meters. In our nation, it is over 70 cubic meters. But the accumulation in firewood forests is only over 10 cubic meters. The potential for increase is very great.

We should also pay attention to reducing the amount of wood as fuel. We should carry out appropriate policies and technical measures so that forest regions and their neighboring farm villages burn wastes produced by the forestry industry. Now, the amount of annual felling of forests in our nation is about 200 million cubic meters. Only 1/3 is handed over to the state. There is a lot of leeway in utilizing wastes.

If these efforts are done well, then after 20 years, the amount of firewood provided rationally by our nation's forests will constitute 1/3 the amount of fuel consumed for living in farm villages at that time. This is truly "keeping the green mountains forever and utilizing them forever."

Actively, Steadily and Soundly Develop Marsh Gas

The efficiency of conversion from fermentation to the use of marsh gas for lighting or cooking is 24 percent. Marsh gas is a clean and high grade fuel with a high thermal value. At the same time, it can conserve a lot of stalks or firewood.

Our nation has abundant resources to produce marsh gas, including stalks of crops, human and animal wastes, tree leaves, aquatic plants and wastes from industrial and sideline production based on agricultural raw materials. The broad regions south of the Chang Jiang have even better water and heat conditions and the results of investment in marsh gas is better.

Nutrients are basically preserved in the raw materials in fermentation (nitrogen loss is only 1 percent). The sediments and water in marsh gas pits are superior quality organic fertilizers. They can effectively improve the nature of the soil, and they can supply nutritional elements to the crops.

Urban sewage can similarly provide farm villages with marsh gas and organic fertilizers after comprehensive treatment.

Our nation already has more than 6 million farm families using small marsh gas pits. The marsh gas produced constitutes 0.5 percent of the amount of farm village energy consumed. We should develop 20 million marsh gas pits during the next ten years through effectively organizing popularization and technical guidance so that the amount of gas produced will constitute 5 percent of the total amount of energy consumed in farm villages.

Our nation's marsh gas production is internationally well known. The Philippines, Brazil and Kenya and the governments of many countries have invited our nation to send experts to build demonstration marsh gas pits. Several dozen countries have sent people to our nation to inspect the experience our nation has obtained in the development of marsh gas to solve the conflicts between farm village energy sources and sources of energy for fuel, feed and light industrial raw materials. These experiences have been popularly noted in Third World nations. We should further develop marsh gas in a big way.

Exert Efforts to Develop Local Superiority

Small hydroelectric power is a farm village energy project that also shares international renown with our nation's marsh gas. In our nation, there are 1,104 counties with small hydroelectric power resources of over 10,000 kilowatts that can be developed. In 1980, the output of small hydroelectric power already reached 12.7 billion kilowatt-hours, constituting 1/3 the amount of electricity used in farm villages (not including county-run industries). They are an important source of energy for living and production in farm villages. We must fully develop this superiority, rely

on local forces to realize comprehensive utilization such as storing water, irrigation, generation of electricity and animal culture.

Small coal pits have served greatly in supplementing the shortage of coal for use in farm villages. In recent years, more than 40 million tons of coal have been supplied to farm villages each year over the past several years. In the future, we should strengthen technical improvements and safe production, rationally utilize resources, and help small coal pits provide more coal to the farm villages.

Others, such as solar energy, wind energy and geothermal energy, have all shown their superiority in different regions. After rational development, they will become reliable and effective supplementary energy sources of the localities. Yongjin County in Gansu Province is situated in the loess plateau. It is dry and it lacks energy. Now, half of the farm families in the county are using more than 13,000 solar stoves. They are used about 200 days out of a year. In combination with firewood-conserving stoves, they have improved the situation of a serious lack of firewood throughout the county.

The energy problem in farm villages involves a broad scientific and technical realm. It is also the major worry of the 800 million farmers. We must strengthen leadership, do long-term and annual work well, conscientiously start out from the practical situation and complete this major task.

9296
CSO: 4013/131

SUPPLEMENTAL SOURCES

EXPLOITATION AND UTILIZATION OF GEOTHERMAL ENERGY IN CHINA

Beijing QUANGUO DIRE XUESHU HUIYI LUNWEN XUANJI [SYMPOSIUM ON GEOTHERMICS IN CHINA, SELECTED WORKS] in Chinese Oct 81 pp 25-28

[Article by Wang Dachun [3769 1129 4783] of the Beijing Graduate Department of the Wuhan Geological Academy: "Several Problems in Developing and Utilizing Geothermal Energy in China"]

[Text] Widespread development and utilization of geothermal energy in the world are recent happenings, therefore it has been called a new energy source. It is generally believed that this is an energy that has an "unlimited" reserve. But, under concrete conditions, various types of problems will occur in the use of geothermal energy. Therefore, considering and studying these problems beforehand to seek appropriate methods of solution have become very necessary work. Opinions concerning the problem of our nation's present development and utilization of geothermal energy have been proposed for comrades to consider.

I. High Temperature Geothermal Fields Are Products of Specific Geotectonic Positions

At present, the world mainly uses the thermal energy of high temperature geothermal fields to generate electricity. It is generally believed that the temperature of fluids (including water and steam) should be higher than 180°C and at least not lower than 150°C before generation of electricity could be economical and rational. The temperature of fluids generally used is above 200°C. Therefore, people believe that only fields with a temperature higher than this numerical value can be considered as high temperature geothermal fields.

At present, there is a total of 40 to 50 high-temperature geothermal fields that have already been developed or surveyed in the world. These geothermal fields are mostly distributed along the edges of plate tectonics--the most popular theory of geotectonics in the world at present. There are fewer questions when this tectonic theory is used to explain the distribution of high temperature geothermal fields.

The edges of plates can be divided into two types according to their properties. One type is the location of growth of the plate. This includes the

oceanic ridges. The thermal flow in the valleys of the ridges is very high, between 3 and 8 microcalories/square centimeter·second. The basalt of the upper mantle surges up continuously from the valley of the ridges. The plates on the two sides move away from each other at a rate of 1 to 10 centimeters a year while at points several hundred kilometers from the mountain ridge, the flow is only about 0.6 microcalories/square centimeter·second. The distribution starts from the central part of the Atlantic, extends northward, passes through Iceland, goes straight to the North Pole and southward around the southern tip of Africa and then turns north and enters the Indian Ocean. Then it divides into two branches. One branch extends westward into the Red Sea, then turns south and passes Ethiopia and Kenya. This is the large rift valley of Africa. The other branch extends towards the east around Australia and then turns north along the western edge of the western part of the North American continent. This zone is mostly situated at the bottom of the Pacific. Only the points that emerge on land produce high temperature geothermal fields, such as Iceland, Ethiopia, Kenya, and the Salton Sea area near the west coast of California in the United States. They are all geothermal fields that are being developed or surveyed.

The edges of a different nature are the regions where two plates collide and die out. The collision of the Pacific Plate and the Eurasian Continental Plate forms an island arc series from Kamchatka to the islands of Japan, Taiwan, the Philippines, Indonesia and New Zealand and the deep ocean trenches in front of the island arc. These ocean trenches are places where the plates dive into the upper mantle. When a plate penetrates to a depth of about 700 kilometers, it is gradually melted and mixed with the upper mantle and then it rises again and approaches or emerges from the ground surface, forming island arcs and a flow of andesite and quartz andesite rocks mixed with basalt-magma in the nearby regions. The high temperature geothermal fields in these regions are mainly associated with this series of magma flow.

The Mediterranean Sea is the region of mutual compression of the African Plate and the Eurasian Plate. The situation is more complex. There may be several small fragmented plates, therefore, high temperature geothermal fields are present in Italy and Turkey on the north side and Algeria on the south side.

At present, there are three known high temperature geothermal regions in our nation, the Yarlung Zangbo Valley, Tengchong Prefecture in western Yunnan and Taiwan. Taiwan belongs to the East Asian island arc described above. Its geotectonic position is relatively clear. Yarlung Zangbo and Tengchong are both situated in the region of collision between the Indian Plate and the Eurasian Plate. The fountains and the fumaroles in Xizang are mainly distributed north of Yarlung Zangbo. Near the Yangbajing geothermal fields now being developed is a relatively broad distribution of neutral and acidic volcanic rocks of the Tertiary. Laifengshan beside Tengchong Town is a very new bocca. The last known eruption occurred about 1600 A.D. The substances spewed out were andesite magma flow. Therefore, it seems that tectonically speaking all of the high temperature geothermal fields already discovered in our nation at present are located in regions of collision of the plates.

The present explanation of the distribution of our nation's geothermal fields uses different geotectonic theories. This is a good phenomenon because up to the present, we have not discovered a geotectonic theory that can satisfactorily explain all kinds of phenomena. To be a geotectonic theory, it must be able to provide a rational explanation of all kinds of geological phenomena. Geothermics is a geological phenomenon, and it must be explainable by tectonic theory. This is the first step. The purpose of explaining it is to seek the laws that control the production of such a phenomenon so that they can be used to guide the search for geothermal energy. This is the work of the second step. Actually, these are tests of the various theories. All existing theories that are proven not to be completely correct should be revised. Completion of the work of these two steps will surely promote geothermal work and geotectonics.

II. Mechanism of Geothermal Fields

The mechanism of geothermal fields first involves the question of the thermal source. At present, it is generally believed that magma underneath high temperature geothermal fields is the main source of heat. Its depth may have to reach 5 to 7 kilometers below the ground surface before it can become a strong geothermal source. As mentioned before, at the places of growth of the plates, the basalt magma flow generally emerges directly from the ground or is very close to the ground surface. Of course, the places where the plates collide and where the conditions can satisfy the requirements to become a thermal source are unlike the places of growth of the plates where high temperature geothermal fields can be seen everywhere. Take Japan as an example, of the four islands, thermal indications are very few on Shikoku Island. Also, for example, in our nation's Yarlung Zangbo Valley, there are many places that lack thermal indications. Considering the thermal sources, it is very possible that this is the result of different depths of the thermal sources. Therefore, we should find the locations where it is possible for lava to approach the ground surface based on various geophysical data and different tectonic theories so as to further study the rational explanation of the distribution of these thermal sources and to better grasp the indications and direction of seeking high temperature geothermal fields.

The second aspect in the mechanism of geothermal fields is the mechanism of water circulation. There are mainly two ways to obtain thermal energy from geothermal fields: One is conduction; the second is convection. Most of the abnormal geothermal regions currently known are caused by convection. At present, the development and utilization of geothermal energy in the world are still at a beginning stage. They mainly rely on geothermal indications and they emphasize the utilization of high temperature fluids. The results of comparative measurements of the isotope H of hydrogen and D and the isotope O^{18} of oxygen and O^{16} have been used to measure high temperature water. It has been determined that over 95 percent come from atmospheric rain water. This brings out the question as to how rain water can approach the thermal sources and produce high temperatures. The simplest situation is that the heat storing system is a water containing stratum. The best results can be obtained by finding the point with the highest temperature, and this is where the water containing layer and the heat source come together. More frequently

crevasse systems. Crevasses conduct water and heat. The questions about the location of the heat source, the paths of percolation of water and how hot water emerges at specific points are all related to the tectonic positions of the crevasse system, its degree of opening and closure, its filling situation and the intersections of the various crevasse systems. In addition, topography and lithological character and such conditions all affect the circulation of water. This requires field work (including the use of various means) to explore the situation. But, because the study of crevasse water is a weak link in hydrogeology, therefore we should also carry out corresponding simulations in the laboratory before we can gradually solve the problems.

III. Comprehensive Utilization of Geothermal Energy

Since 1812, the Italians have been using hot springs to extract borax. Initially, firewood was burned to boil and evaporate water and condense it. By 1827, 15 years later, the steam from the fumaroles was used to replace firewood. Not long afterwards, the first well was sunk. This increased the amount of water containing borax and it was also used as fuel. This actually was low level comprehensive utilization. Later, the fumaroles were used to generate electricity as a way of energy utilization. People realized that hot water frequently contained special components and under some situations the contents were very high. Therefore, in recent years, some of the nations that have more widely developed and utilized underground thermal energy have already begun to make plans to establish comprehensive utilization of underground thermal energy. For example, Japan plans to utilize highly mineralized hot water to build a factory which can generate 7,000 kilowatts of electricity and at the same time produce 100,000 tons of edible salt a year and a definite amount of fresh water. Iceland is also planning to establish a system to utilize high temperature hot water (270°C) with a mineralization of 29 grams/liter to extract various types of salts and to generate electricity at the same time.

The high temperature hot water in our nation's Xizang has a very high content of boron and fluorine and such elements, rarely found elsewhere in the world. If ways to extract those elements are found, very precious mineral raw materials can be increased. If they are allowed to flow away after the hot water is used to generate electricity, they will become a polluting source and their benefits and harm will be widely divergent. Thus the necessity of comprehensive utilization can be seen.

In some medium and low temperature hot water, the contents of various types of salts are also relatively high. For example, the hot water in the oil wells at Shashi on the southern banks of Changjiang not only has a high content of salt, the content of iodine is also very high and they are worth extracting. Therefore, the comprehensive utilization of hot water (including high temperature water and medium and low temperature water) is a very good way to develop the beneficial and eliminate the harmful.

To catch up with the advanced levels of the world, we should begin testing and studying the comprehensive utilization of energy sources and resources before large-scale development or utilization of geothermal energy so that when large scale development begins in the future, there will be very good scientific references and comparatively rational technological flow processes.

IV. The Question of Rationally Utilizing Medium, Low and High Temperature Hot Water and Improving the Efficiency of Generating Electricity

The development and utilization of geothermal energy begin from high temperature hot water. But the number of high temperature hot water regions on earth is limited, therefore, we have also utilized dry hot rocks. This is actually artificial high temperature hot water. Yet, that which is truly distributed widely is medium and low temperature hot water. This is one point. The second point is that hot water is not necessarily present in regions that need energy. It can be used to generate electricity for long distance transmission. Therefore, geothermal electricity generation is a method to solve the incoordination between the distribution of geothermal energy and the regions that use such energy. Actually, the most effective way to utilize underground hot water is direct utilization. This is because the generation of electricity actually utilizes only a small portion of thermal energy, therefore, at present, the most effective method to generate electricity is still being sought.

New Zealand is a nation relatively advanced in the utilization of geothermal energy. The Taupo depression belt of North Island extends 209 kilometers and is 20 to 30 kilometers wide. But New Zealand still advocates direct utilization. After natural gas fields were discovered, it terminated plans to enlarge geothermal electricity generation and changed to direct utilization. This was because the efficiency of using geothermal energy to generate electricity was not high. Therefore, one of the existing problems at present is to study ways to improve the efficiency of utilization of high temperature hot water and steam to generate electricity.

On the other hand, the distribution of geothermal energy in our nation shows that most of the energy is distributed in areas of medium and low temperature hot water. Of course, we should study how to directly utilize it in industrial and agricultural production and in life. In addition, studying ways to improve the efficiency of generating electricity by medium and low temperature hot water is also an important aspect. At present, our nation already has 9 power stations that utilize medium and low temperature hot water to generate electricity. But the amount of electricity generated is all very small and it does not have a lot of use in actual production. Economically it is not rational and it can only be used for experimental and research work. But since we do not yet have sufficient strength to carry out research and improvement of every power station, I personally believe the operation of some of these power stations can be stopped so that the limited manpower, materials and funds can be concentrated at three points to carry out special research and experiments to generate electricity. Such a power station does not need to be included in economic and acc unting considerations. Its task is to study and explore ways to improve the efficiency of generating electricity by medium and low temperature hot water and to establish a foundation for widespread application in the future. In general, research should be intensified in the effective utilization of high temperature hot water, in efforts to improve the efficiency of utilization of medium and low temperature hot water, and direct applications in production and living to improve our level of work in these regards.

.. In the Development and Utilization of Geothermal Energy, We Must Pay Attention to Preventing Pollution and Other Problems

The popular saying is that geothermal energy is a clean energy source. This is not without reason. A lot of geothermal energy indeed does not involve pollution problems. But sometimes hot water or steam contain harmful components which can pollute the air and water. After release, they can also cause pollution. For example, the geysers in the United States contain more boron and ammonia. The condensed steam cannot be released after use. They tried pumping it back to a depth of 2,000 meters to prevent pollution. It seems that pumping the condensed water vapor back into the water containing layers should not produce any problems, but they believed that even though a year of tests to pump back condensed water vapor have not caused any trouble, it is still difficult to guarantee that nothing will go wrong. Also for example, the hot water in El Salvador cannot be released because it contains more boron, chlorine and arsenic, and El Salvador also tried the method of pumping the water back into the water containing layers. The tests were conducted for 2 years and this did not affect the producing wells. But, there is a possibility that the refilling wells may be blocked by SiO_2, and therefore the problem is still being tested and studied. It can be seen that the prevention of water pollution after using geothermal energy to generate electricity should also be a problem in the utilization of geothermal energy.

Some steam contains such harmful gases as H_2S and SO_2. When they are released into the air, they will also cause pollution. In addition, they will also erode the equipment for generating electricity. For example, the Odake Prefecture in Japan used geothermal energy to generate electricity. Originally five producing wells were used but after 3 years, silicates caused sedimentation in the wells and one had to be covered. In addition, the SO_2 contained in the steam caused some erosion problems. Later, a vacuum jet was installed and the problem was solved. The problem of SiO_2 in hot water depositing in the pipes can be solved by installing a sedimentation tank. The method is to let the water remain in the tank for 1 hour so that SiO_2 can deposit at the bottom of the tank. The turbine is shut down for inspection and repairs once a year to wash away the SiO_2 deposits. The equipment has always worked well in this way and the working load has reached 96 percent. Later, the equipment was inspected and repaired once every 2 years and the results were not bad. It is not difficult to see from this that many components in water and steam can hinder the generation of electricity. We should fully learn foreign experience and lessons in this regard and estimate the various problems that might be encountered beforehand and study them to avoid repeating foreign mistakes.

Our nation's Yangbajing geothermal fields in Xizang have already begun generating electricity. But it seems that there are two problems that have not been noticed. In the composition of the hot water, the content of H_2S is 3 to 6 milligrams/liter. The content of SiO_2 is 100 to 250 milligrams/liter. Not only so, the content of boric acid in the steam can reach 77.6 milligrams/liter and the content of H_2S can reach 8 milligrams/liter, etc. All of the H_2S, arsenic, boron, fluorine whether in water or in steam will obviously cause pollution when released after the water and steam have been used to generate electricity. This problem should be rapidly studied and solved. Otherwise, if we wait until visible damage has been caused, it would be too late.

On the other hand, the content of SiO_2 in water is not small. The cementation of the water containing layer of sandy psephyte is the result of SiO_2 deposits after the temperature of the hot water has dropped. This situation of course will also be repeated in the course of generating electricity. In view of foreign experience, it seems that this is also the necessary result. The problem is that under our present operation to generate electricity, what is the rate of deposition and what measures can be appropriately taken to eliminate it. This is a problem that must be studied and determined according to our situation.

In addition, there are also some problems that are worth considering. For example, the temperature of the hot water being exploited and utilized at Yangbajing in our nation at present is only 130°C to 160°C. But the amount of water produced can reach 2,200 tons/day. Analysis of the lithological composition of the hot water system, the amount of flow and the temperature indicates that it may be a water containing layer of sandy psephyte heated by the temperature and the steam in the heat storing system underneath. The actual heat storing system may very possibly be located at a deeper depth in a certain section of the upper reaches of the water containing layer of sandy psephyte. This should be the true target of prospecting. This is a problem that should be studied. Of course, there are still other problems which will not be discussed here.

Finally, another point should be mentioned. That is, many problems may emerge during the course from prospecting to utilization of geothermal energy to generate electricity. It is not an easy task to do this work well. It is hoped that the leading agencies can fully consider as much as possible the complexity of these problems, avoid issuing orders "to generate electricity within a fixed time limit" and avoid causing unnecessary loss because of insufficient preparatory research and hasty moves.

9296
CSO: 4013/99

BRIEFS

METHANE GENERATOR--With the cooperative assistance of the Shanghai Leather Industry Research Institute and the Shanghai Internal Combustion Engine Research Institute, the Shanghai Hongguang Tannery uses the tannery waste water and mud of its own plant and that of the neighboring Hongwei Tannery to produce methane through fermentation and supplies the "double fuel of methane-diesel oil" for the internal combustion engine which successfully powers a 5,000 kilowatt generator to produce electricity. This experimental unit uses a 15 percent diesel oil to start the engine and the supply of methane and diesel oil is automatically regulated according to external load changes. It is calculated that each 0.65 cubic meter of methane can generate 1 kilowatt hour of electricity. Each cubic meter of leather methane is equivalent to 0.85 kilograms of standard coal. The Hongguang and Hongwei tanneries currently discharge 3,000 tons of high concentration albumen colloidal waste each day. If the entire quantity is treated, 4,000 cubic meters of methane can be produced each day. If this is used as fuel to supply a 250 kilowatt methane power station operating on a 24-hour continuous basis, 1.85 million kilowatt hours of electricity can be generated annually and 1,000 tons of standard coal can be saved for the state. Calculations show that the entire investment for the construction of a 200 kilowatt methane power station can be recovered in 1 to 5 years. This will not only save large amounts of funding and power needed for the treatment of the three wastes but also open a new road for the prevention of urban pollution and the development of energy source potentials. [Text] [Shanghai DIANSHIJIE [ELECTRICAL WORLD] No 1, 1982 p 35] 5974

GEOTHERMAL POWER PLANT--The Yangbajing thermal experimental power station in Xizang is our country's first power station that directly utilizes geothermal steam for power generation. The 1,000 kilowatt unit, the first one installed, had operated for more than 26,000 hours by September 1981 and generated over 8.9 million kilowatt hours of power. The "light of geothermal" has illuminated the Xizang plateau. Currently, the second stage project with an installed capacity of 6,000 kilowatts has also entered its key stage of installation. (Note: A 3,000 kilowatt unit was completed and started power generation in November 1981.) [Text] [Shanghai DIANSHIJIE [ELECTRICAL WORLD] No 1, 1982 p 35] 5974

CSO: 4013/108

'RENMIN RIBAO' ON SHANGHAI ENERGY CONSERVATION

HK230811 Beijing RENMIN RIBAO in Chinese 20 Sep 82 p 5

[Article by Yao Xitang [1202 6932 2768] and Jin Xingren [6855 5887 0088]: "An Inquiry Into the Economic Results of Energy Conservation in Shanghai"]

[Text] The scope of energy conservation in Shanghai is very broad. In the last 5 years, Shanghai's industry has achieved steady development mainly on the basis of energy conservation. Compared with 1976, energy consumption in 1981 increased by only 12.2 percent, but the industrial output value increased by 43.7 percent. However, with the change in energy conservation methods and the development of energy conservation from a low level to a high level, difficulties in energy conservation have become harsher and investment in energy conservation needs to be increased. Shanghai's practice in energy conservation shows that energy conservation through different methods and at different levels will bring about obviously different economic results. Therefore, in order to further promote energy conservation in Shanghai and achieve greater successes in this respect, one of the important questions which urgently needs to be solved is to seriously analyze the economic results of different measures for energy conservation and seek better ways for energy conservation so as to achieve better results with a fixed investment.

Measures for Energy Conservation and Their Economic Results

In Shanghai, the objective of energy conservation is to utilize all energy in a most economical and effective way, that is, to produce as many products needed by the society and create as much profit and as high an output value as possible with a fixed quantity of energy. Therefore, all measures which can save energy, reduce energy consumption and substitute an expensive form of energy with a cheaper one fall into the scope of energy conservation. To sum up, these measures can be divided into the following three main areas: 1) readjust the economic structure (including industrial structure, product makeup and enterprise setup), and reduce energy consumption, so as to indirectly conserve energy; 2) strengthen management, rationally organize production and prevent wastage of energy, so as to reduce the waste of energy; 3) carry out technical transformation concerning energy conservation and continually lower energy consumption by unit products.

By calculating the total energy conserved through the above three methods, each dun of standard coal saved in Shanghai in the last 5 years needed an average of

unit of yuan in investment. But an analysis of energy conservation results shows that three areas took an unequal share in total energy conservation: measures for indirect energy conservation centered on adjusting the economic structure account for 50 percent; measures for conserving energy by mainly strengthening management account for 25 percent; and measures for technical transformation account for the remaining 25 percent. The first two areas--indirect energy conservation and energy conservation by managerial measures--need no investment in the main. So if all the energy conserved in the last 5 years in Shanghai was achieved through technical measures, the average investment for saving a dun of standard coal would be 200 yuan. Moreover, the unit investment in energy conservation through technical transformation will rapidly rise when difficulties in energy conservation become harsher.

Thus it can be seen that the economic results of energy conservation are closely related to relevant measures. One of the important reasons why Shanghai has achieved excellent results in energy conservation over the last 5 years is because indirect energy conservation and energy conservation by managerial means took a large share. (These two areas accounted for a total of 75 percent.) Therefore, in the next 5-10 years, in order to maintain an excellent economic result in energy conservation in Shanghai, it is necessary, while further carrying out technical transformation concerning economic conservation, to continue to pay close attention to indirect energy conservation and energy conservation by managerial means, which constitute two important areas of energy conservation.

Shanghai is an industrial city where almost all of its energy resources need to be shipped in from other regions. In Shanghai, the proportion of the metallurgical and chemical industries, which heavily consume energy, in the industry as a whole is larger than their proportion in the whole country. In 1980, the energy consumption of these two industries accounted for more than 50 percent of total industrial energy consumption. Therefore, there is still great potential for adjusting Shanghai's product makeup. If Shanghai's production of products which heavily consume energy, such as steel, iron alloy, chemical fertilizer and calcium carbide, can be appropriately controlled and reduced, and the valuable energy can be shifted to develop products with low energy consumption and high output value, such as electronic, textile and mechanical products, more energy will thus be saved and conserved and unit energy thus will be worth a higher value.

It should be particularly pointed out that besides the readjustment of the economic structure, an extensive sphere and many other ways for indirectly conserving energy exist in Shanghai, a comprehensive industrial city which consumes large quantities of energy and various raw materials. In 1980, Shanghai produced 5 million dun of steel and 4 million dun of special steel products. This shows that 80 percent of all steel was processed into special products. If 1 percent more of steel is processed into special products, that means steel products can increase by 50,000 dun and 75,000 dun of energy can indirectly be saved. This shows that great potential can be tapped. In the same year, Shanghai consumed 2.48 million dun of steel products, but its utilization rate was not high. The utilization rate of steel products in 900 mechanical and electrical products was only 70 percent. And the utilization

rate in more than a dozen farm machines was as low as 50 percent. If efforts are made to raise the utilization rates, energy in a considerable quantity can thus be saved. Every year, Shanghai also consumes many products which have heavily consumed energy--for example, 4 million dun of pig iron, 2 million dun of cement, 200,000 dun of copper and copper products, 400,000 dun of sulphuric acid and 250,000 dun of caustic soda. Waste and losses in every field were rather serious. It can be seen that indirect energy conservation has great potential. Successful work in this respect will greatly contribute to improving the comprehensive economic results of energy conservation.

Energy conservation through managerial means is also a useful way to achieve good economic results while no money is spent. For Shanghai as a whole, rationally organizing energy transportation and distribution, establishing specialized coordination centers for handling casting, forging, heat treatment, electroplating and oxygen-making, and strengthening comprehensive energy utilization are all effective measures for energy conservation. In every enterprise, meticulously organizing production can also save great quantities of energy and achieve better overall economic results in energy conservation.

[HK230813] The Development Stages of Energy Conservation and Their Economic Results

According to foreign experience and Shanghai's practice in recent years, energy conservation through technical measures can be divided into four stages: 1) preventing palpable waste of various types of energy and eliminating energy leakage in the process of production and transportation; 2) strengthening dispatch work, rationalizing operation and carrying out extensive minor reforms in equipment; 3) partially transforming technology and equipment and improving energy utilization rates; 4) carrying out all-round technical transformation and adopting new equipment and technology which can consume less energy. Shanghai's energy conservation work in recent years was mainly at the first two stages and initially entered the third stage. In general, the work required low investment but yielded good economic results, returns equal to investment can usually be realized in 1 or 2 years. Viewed from the economic results, the emphasis on energy conservation through technical measures in enterprises should first be put on these stages whereby more and better results can be achieved with little money. Practice has proved that it is not a correct approach to neglect meticulous work at these stages and blindly develop large-scale technical transformation projects. Only after having achieved successes at the first stages can we gradually carry out partial reform on a large scale and overall technical transformation. Careful analysis of availability must be made for those necessary large-scale energy conservation projects. The correct approach is to choose and start with some projects which have mature technical results. It is inadvisable to rush headlong into mass action without considering the economic results. A few years ago, some enterprises neglected this basic work and looked down on minor reforms. They blindly embarked on quite a few projects of generating electricity with remaining heat. As a result, they failed to achieve the expected success, and some even failed to repay bank loans for these projects.

All trades should make their plans in accordance with their specific conditions, choose suitable items for handling energy conservation in a methodical

way and seek step-by-step development so as to achieve better economic results in this work.

Strengthening Energy Conservation Management, Striving To Achieve Better Economic Results

China's principle for developing energy is to "lay equal stress on both exploitation and conservation and give priority to conservation in the near future." Energy conservation has become an important factor for maintaining a steady growth in our economy. This is of special significance in Shanghai. Many measures for energy conservation are put forth in various trades. Therefore, an important link in the work of energy conservation is to strengthen management over these measures, seriously study the economic means and investment items for energy conservation and strive to achieve better economic results in energy conservation.

Efforts should be made in all fields of energy conservation to change Shanghai's economic structure into one of energy economization. Great efforts should also be made to conserve various raw materials and materials which are heavy energy consumers, so as to improve the overall economic results and achieve the greatest results with the least investment. It is not economical to handle energy conservation merely carrying out many large-scale technical projects without attaching importance to all-round measures including those that can indirectly conserve energy.

For carrying out technical transformation, all enterprises and departments should proceed from their respective conditions by analyzing energy conservation items at different stages, choosing and starting with the most suitable items which can bring in the best economic results.

The current stress on investment for energy conservation should still be maintained on minor reforms and partial equipment innovations which can yield good results in energy conservation and general economic areas so that the limited funds for energy conservation during the readjustment of the national economy can turn over rapidly and yield the greatest benefits.

Technological-economic analysis reports must be prepared before any energy conservation items, especially those of importance, are begun. These reports should respectively be submitted to the higher authorities for examination. When major items are examined, relevant technical experts and economists should be invited. Only after their analysis after examination show that the items are technically available, economically favorable, financially guaranteed and beneficial to the national economy as a whole can decisions be made on these items and be put into practice.

It is necessary to strengthen banks' supervision over energy conservation items. If an item involves many fields, after the departments concerned at higher levels have examined and approved it, banks should further examine its main contents and economic results if loans are to be offered for use.

CSO: 4013/7

CONSERVATION

ZHEJIANG PARTY COMMITTEE, GOVERNMENT ISSUE SPECIFIC REQUIREMENTS FOR ENERGY CONSERVATION

Hangzhou ZHEJIANG RIBAO in Chinese 8 Jul 82 p 1

[Article by Fu Cong [0265 3222]: "We Must Persist in the Guiding Ideology Centered Around Energy Conservation for a Long Period; Provincial Committee and the Provincial Government Issue Specific Requirements To Conserve Energy"]

[Text] The provincial committee and the provincial people's government recently held a meeting to discuss the energy problem. The meeting asked the party committee, the governments, the departments and the units at each level to persist in the guiding ideology centered around energy conservation for a long period, conscientiously grasp energy conservation to assure the development of the national economy and social endeavors.

The meeting pointed out that our province has a shortage of energy. In particular, coal resources are deficient. This has already become an important limiting factor in developing the national economy. The way to solve this problem is mainly by grasping energy conservation tightly. It is important to grasp the following three tasks at present: First, actively readjust the product structure so that industrial production of the whole province can gradually advance towards establishing a product structure that is highly efficient and that conserves energy. In particular, certain products of the chemical industry, the metallurgical industry and building materials industry that consume a lot of energy must first be readjusted to gradually change the irrational utilization of energy resources. Second, we must carry out technical improvement centered around energy conservation well. We must first grasp the renovation and rebuilding of boilers, vehicles, transformers, water pumps, blowers and industrial kilns and such major equipment that consumes a lot of energy. We must develop the utilization of surplus heat, establish special technical centers for heat treatment, electroplating, forging and casting in cities where industries are more concentrated. We must advocate the method of establishing heat supply stations for small areas joining several neighboring enterprises. Third, we must grasp energy management tightly. We must establish fixed quotas for energy consumption in the production of major industrial products, insist on the principle of supplying energy to superior units.

The key units that consume over 10,000 tons of standard coal a year in the province must implement effective technical measures to strengthen the weak links and to continue to improve the rate of utilization of energy. Each prefecture and department must establish energy conservation goals and specific plans for implementation over several years to truly lower energy consumption.

The provincial committee and the provincial government decided to establish an energy leading group and asked the governments at each level to establish corresponding energy leading groups, to exercise unified commands, and to coordinate plans related to energy, cooperation, promotion of readjustment, production, supply, management and scientific research.

9296
CSO: 4013/128

CONSERVATION

MAJOR ENERGY CONSUMERS URGED TO LEAD ENERGY CONSERVATION

Hangzhou ZHEJIANG RIBAO in Chinese 5 Jul 82 p 1

[Article: "Major Energy Consumers Must Lead Energy Conservation, Officials of the Provincial Economic Committee, Related Departments (Bureaus) and Companies Inspected the Work of Nine Key Energy Consuming Enterprises, Each Unit Actively Implemented Energy Conserving Measures to Conserve Energy Well"]

[Text] Recently, comrades of the provincial economic committee and related provincial departments (bureaus) and companies heard reports on energy conservation by nine key energy consuming enterprises of the Hangzhou Steel Mill, the Hangzhou Glass Factory, the Hangzhou Longshan Chemical Plant, the Hangzhou Electrochemical Plant, the Hangzhou Cement Plant, the Jiaxing Chemical Fertilizer Plant, the Huzhou Chemical Fertilizer Plant, the Jiaxing Minfeng Paper Manufacturing Plant, and the Shaoxing Steel Mill. They also went to the factories to inspect the implementation of energy conserving measures and asked the whole province's major energy consumers to quickly produce results in energy conservation.

The reports and the inspections showed that most enterprises realized definite achievements in strengthening management of energy conservation and in developing technical improvements centered around energy conservation. Among these nine factories, 8 of them registered an increase in production value and profits from January to April of this year compared to the same period last year while the consumption of energy dropped from the same period last year. A total of more than 13,400 tons of standard coal was conserved. The comparable energy consumption of the Hangzhou Steel Mill was 1.034 tons, a drop of 0.05 tons from the same period last year, next only to Capital Steel Company and ranking second in the same profession nationally. But, these factories still have a lot of potential in conserving energy. For example, if the Huzhou Chemical Factory can grasp the implementation of technical improvements in energy conservation, it could conserve an equivalent of over 1,900 tons of standard coal a year. If Hangzhou Steel Mill can further its energy conservation work, it can conserve another 15,000 tons and more of coal a year.

The leading comrades of the provincial economic committee and related departments (bureaus) also understood and discovered problems that urgently

need to be solved in energy conservation at these factories at present. One, some factories did not establish special energy conservation agencies, and they did not grasp energy management work tightly. Second, they installed only a few meters to measure energy consumption. They used energy as if "eating from the big pot." The Shaoxing Steel Mill basically does not have any meters to measure the use of water and waste is serious. Some factories can utilize surplus heat but they have not fully utilized it. For example, the Hangzhou Longshan Chemical Factory discovered in tests that 840,000 kilocalories of surplus heat are released in the gas from the manufacturing of each ton of synthetic ammonia. If the heat of the smoke from the ammonia soda drying furnace is utilized, each day, it can produce 12 tons of steam. Third, the rewards system for energy conservation is not rational enough. Some enterprises have established overly low standards for rewards in energy conservation and wasting of energy is also rewarded. Some enterprises use the method of sharing to reward energy conservation and thus hinder the function of energy conservation rewards to encourage advanced efforts and stimulate lagging efforts.

The reports and inspection stimulated these nine key energy consuming enterprises to implement energy conserving measures. The Hangzhou Steel Mill strengthened operational management of the 6000-kilowatt steam turbine generator of the power plant by aiming efforts at the mill's own weak links. The coal gas originally released from the coking furnace was rechanneled into the generator boiler. Large lumps of coal were precrushed, thus the consumption of coal to generate electricity dropped by 12.8 percent. Jiaxing Minfeng Paper Plant provided technical training in energy conservation for members of the energy conservation group of the shops and energy conservation supervisors of each work section and shift. This has forcefully improved the management level in energy conservation by the whole plant.

9296
CSO: 4013/128

BIGGER FINES SUGGESTED FOR FAILURE TO LOWER ENERGY CONSUMPTION

Hangzhou ZHEJIANG RIBAO in Chinese 5 Jul 82 p 1

[Article by commentator: "The Urgent Task of Large Energy Users"]

[Text] Our province has 135 enterprises that consume an equivalent of over 10,000 tons of standard coal in energy each year. Their energy consumption constitutes over 70 percent of energy consumed by industry. Whether the rate of utilization of energy by the province's industry can be improved on a large scale is determined by whether large energy consumers can progress by a large scale in energy conservation.

To push energy conservation of large energy consumers forward and reduce energy consumption, the elimination of "pride" is a key. Energy conservation of some large energy consumers is not done well because of "pride." They consider themselves key enterprises and emphasize guaranteeing supply. They supply as much as they need and regardless of the shortage they will "guarantee" their own supply, therefore, they use energy wastefully and they waste energy at will. This way of thinking is wrong. So-called guaranteeing supply does not mean that wastefulness is allowed. Recently, the provincial economic committee has notified 11 enterprises which have consumed too much energy. Many of them are key enterprises. All key enterprises must learn the lesson.

Energy conservation, regardless of profession and regardless of what products are manufactured, must be emphasized by all. Enterprises that produce products that are in short supply generally have a greater potential for energy conservation. In this sense, these enterprises should grasp energy conservation work even better. They should see that our energy conservation work is still far behind the advanced levels! There is always something better elsewhere. Even some of the enterprises that have reached the advanced level in conserving energy still lag behind others in many aspects. All thoughts of self contentment are inconsistent with the actual situation in our province and such thoughts should not be entertained.

Grasping energy conservation is to grasp the large energy consumers. At present, we must first inspect the implementation of energy conserving measures, learn from the advanced, seek out the gaps, use the advanced as the model, concretely push energy conservation further. In particular,

those enterprises that use too much energy must be urged to reduce their energy consumption by strong and forceful measures. Enterprises that do not reduce their energy consumption over a long period should limit their production, cease production or be fined more severely according to regulations. Therefore, it is hoped that all large energy consumers will conscientiously strengthen energy conservation, concretely conserve energy for survival, use energy conservation to realize speed and use energy conservation to seek development.

9296
CSO: 4013/128

CRITICIZED, ENTERPRISES REDUCE ENERGY CONSUMPTION

Hangzhou ZHEJIANG RIBAO in Chinese 5 Jul 82 p 1

[Article: "Conscientiously Accepting Criticism, Concretely Grasping Energy Conservation; Eleven Plants Including Wenzhou Chemical Plant Reduced Energy Consumption"]

[Text] Eleven enterprises, including the Wenzhou Chemical Plant, that were notified and criticized by the provincial economic committee for consuming too much energy actively improved work with the help of the local governments and concerned departments. During recent months, their energy consumption visibly dropped. By the end of May, the energy consumption of the seven factories of the Wenzhou Chemical Plant, the Pingyang Nitrogenous Fertilizer Plant, the Linghai Chemical Fertilizer Plant, the Chunan Cement Plant, the Jiaxing Cement Factory, the Xinchang Cement Factory, and the Hangzhou Printing and Dyeing Factory had dropped to below the maximum limit for single unit consumption established by the province. Although energy consumption of the Leqing Nitrogenous Fertilizer Plant, the Xianju Silk Factory, the Quzhou Silk Factory and the Huzhou Cement Plant did not drop to the provincial standards, it dropped by a large scale from the previous level of consumption.

After these eleven factories were criticized, they conscientiously inspected the problems that existed with the help of city and county administrative departments of their localities, lifted their spirits, improved the style of work, strengthened leadership, exerted efforts to lower energy consumption as quickly as possible. The Hangzhou Printing and Dyeing Plant readjusted and strengthened the energy conservation leading group of the party headquarters of the plant and correspondingly established an energy conservation group in the shop and an energy conservation officer in the shift, and preliminarily formed a three level energy management network. The staff of the Quzhou Silk Factory including the plant manager and the secretary all understood the duties of energy management, strengthened management of boilders and coal piles, and each day, they posted the actual energy consumed by each shift, and established energy consumption indices as conditions for evaluation and giving of awards by the leadership. The Chunan Cement Plant organized cadres above the shop director level to join the shift in work, grasped first hand data, and solve the problems in time. It also decided to withhold monetary awards to all members of the factory

before energy consumption dropped, and deducted 5 percent of the wages of the plant leadership. In technical measures, each plant mainly organized activities for technical improvement centered around energy conservation. The Pingyang Nitrogenous Fertilizer Plant always used cement coal briquets as raw material in the past. Thermal stability was low and the amount of white coal used was high. Now, it has changed to using the new technique of carburized coal briquets. In half a month, the amount of white coal consumed per ton of ammonia dropped 516 kilograms. The Jiaxing Cement Plant originally burned 1.3 tons of coal to operate its baking room. Now, after rebuilding the furnace chamber, the two furnace doors were changed to one furnace door, and the daily amount of coal consumed dropped by 0.4 tons. The Xinchang Cement Plant used local resources and mixed fuel with oil shale and reduced coal consumption. The Hangzhou Printing and Dyeing Plant utilized two holidays when the plant was shut down to concentrate technical forces to inspect, repair and rebuild its machinery. Three main shops using steam were repaired and 23 gas leaks were plugged. The Wenzhou Chemical Plant clarified the duties of maintenance and repair workers and improved key equipment that easily malfunctioned, increased reserve equipment, and guaranteed normal operation of the equipment.

Although these eleven factories improved, compared to the advanced levels of other units in the same profession, they are still far behind. At present, cadres and workers of these factories are continuing to carry out technical improvements centered around energy conservation to strive to reduce energy consumption further within a short period and to realize better economic results.

9296
CSO: 4013/128

SUPPLEMENTAL SOURCES

ECONOMIC, POLLUTION CONSIDERATIONS OF GASOLINE/METHANOL MIXTURES EXPLORED

Chongqing XIN NENG YUAN [NEW ENERGY SOURCES] No 5, 5 May 82 pp 49-53

[Article by Fuel Mixture Testing Section, Sichuan Fiber Factory: "Gasoline/Methanol Fuel Mixtures for Automobiles"]

[Text] As early as the 1930's, not long after the synthesis of methanol, research was begun in Germany on the use of methanol as an automobile fuel.[1] During the Second World War, methanol was used for engine fuel in Germany and the Philippines.[2] Since the Middle East War in 1973, large amounts of manpower and material resources in England, the U.S., Japan, Germany, and other countries have been devoted to study gasoline-methanol mixtures as automobile fuels in order to develop alternative sources of fuels and to solve the energy crisis, and there has been rapid progress.[3-6] Outside of China, there are three main approaches at present to the use of methanol as a fuel: (1) methanol as a substitute for gasoline; (2) gasoline-methanol mixtures as automobile fuels; and (3) synthetic automobile fuels from methanol. The second approach has been the most popular one, and certain achievements have been made.

In China, the Taiyuan Chemical Fertilizer Plant and other organizations have been testing methanol-gasoline mixtures as automobile fuels and have made progress.[10]

The octane value of methanol is quite high. The theoretical heat of combustion is also quite similar to gasoline. The gasoline-methanol combination is an ideal mixture for fuels. Not only is there the opportunity to save large amounts of gasoline, but also there is a new energy source for our country. Thus there may be very important consequences.

Starting from last November, our factory has done intensive testing on gasoline-methanol fuel mixtures and has made certain progress. Because of the better anti-knock properties of the mixed fuels as compared to pure gasoline, both dynamometer and road tests have found that power and economic characteristics of gasoline-methanol fuel mixtures are either close to or superior to pure gasoline. Proper understanding of various characteristics would probably give us blends that are superior to gasoline and the results would be very satisfactory.

I. Physical Properties of Gasoline and Methanol

The physical properties of gasoline and methanol are quite different. Compared to gasoline, combustion of methanol requires 44% of the amount of air, and the heat of combustion is only 45% of gasoline. The heat of vaporization of methanol is a factor of 3 higher than gasoline. The octane value of methanol is about 8 units higher than high quality gasoline. Methanol may be mixed in any ratios with water, whereas gasoline basically is insoluble in water. Thus pure methanol or methanol-gasoline mixtures with high methanol contents are unsuitable for use in motor vehicles produced in China. However, the dynamometer and road testing results have shown that fuel mixtures containing 10-30% methanol may be readily used.

II. Properties of Gasoline/Methanol Fuel Mixtures

1. Miscibility of gasoline and methanol

The miscibility between gasoline and methanol depends on temperature and the composition of gasoline. In order to study the effects of temperature on the miscibility of gasoline and methanol, we have carried out experiments at various temperatures with 70# gasoline and high quality methanol from our factory. The results are given in Fig. 1 as the binary phase diagram of the gasoline-methanol system. The region above curve A is the miscible region. The region below curve A is the separation region. It may be seen that the temperature effects are quite prominent in the miscibilities of gasoline and methanol. Special attentions should be given to these effects when fuel mixtures are used. For example, above 32°C, methanol and gasoline are miscible in any proportions. The solubilities of methanol in gasoline decrease very rapidly when temperature changes from 32°C to 20°C (from about 35% to 10%). The solubility decreases (increases) by about 2% for every 1°C drop (rise) in temperature. When temperature decreases from 20°C to 0°C, there is a slow decrease in solubility from about 10% to 5%.

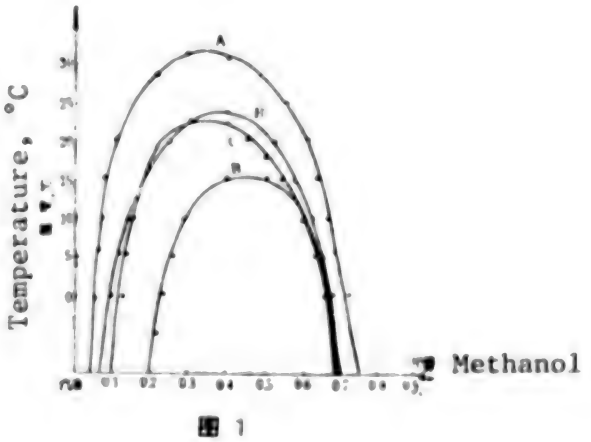


图 1

Fig. 1

In order to improve the solubility of methanol in gasoline, we have carried out experiments where additional components are added. The results are shown as curves B, B' and C in Fig. 1. Comparisons of curve B (addition of 1.5% n-butanol) or curve C (addition of 3% acetone) with curve A clearly show the change in the solubilities of methanol in gasoline.

2. Effects of water

Although gasoline itself is insoluble in water, it can pick up moisture easily after mixing with water. Furthermore, gasoline-methanol mixtures would separate into layers after absorbing more than the allowed amount of moisture. We have carried out experiments on methanol and methanol-gasoline fuel mixtures in order to study the effects of water on these fuels. Our experimental results are as follows: (1) The average amount of water absorbed by pure methanol is 0.064% and is approximately a factor of 6 or 7 higher than gasoline-methanol mixtures; (2) Although the addition of n-butanol does not influence significantly the amounts of water absorbed by gasoline-methanol mixtures, we have found that the mixtures with n-butanol did not separate into layers after 5 days, whereas the mixtures without n-butanol began to separate into layers after only 3 days. Obviously, the addition of n-butanol increases the moisture resistance of these fuel mixtures. In addition, we have tested the moisture resistances of mixed fuels with various amounts of methanol in the absence of additional components. Our experimental results indicate that the moisture resistances are higher at elevated temperatures and at higher methanol contents for gasoline-methanol fuel mixtures.

The allowable amounts of moisture in gasoline-methanol fuel mixtures also vary with the aromatic hydrocarbon contents of the gasoline.[7,8] If the aromatic content is high in the gasoline, the allowable moisture content in the fuel mixture and the moisture content are also high.

3. Moisture resistance with the addition of a third component

We have asked whether the addition of a third component would improve the moisture resistance in addition to the better miscibility. Our experimental results have indicated that the moisture resistance has the sequence n-butanol > isobutanol > isopropanol > acetone. It may be seen that the third component not only improves the miscibility of gasoline and methanol, but also improves the moisture resistance of the fuel mixture. Our results are in general agreement with the literature.[8]

III. Testing of the Characteristics of the Gasoline/Methanol Fuel Mixtures

1. The question of heat values

It is well known that engine efficiencies are influenced by the heat values of a standard cubic meter of the combustible gas mixture rather than the heat value of the fuel itself. For oxygen-containing fuels such as methanol

of ethanol, the heat of combustion is somewhat low, but so is the theoretical amount of air required for combustion; the theoretical heat value of the combustible gas mixture is actually slightly higher than gasoline. It may be seen that the theoretical heat value of combustible gas mixtures using gasoline-methanol fuel mixtures is not inferior to pure gasoline. Substitution of fuel mixture for pure gasoline would not decrease the engine efficiency and may even improve the thermal efficiency. This has been confirmed by dynamometer tests.

2. The question of octane values

The octane number is an important index for the antiknocking quality of gasoline for automobiles. The higher the octane number of the fuel, the better the antiknocking characteristics; the engines can then operate at higher compression ratios with better gasoline mileage and saving fuel. This has important consequences for improved qualities and economics of the petroleum products. In order to study the effect on the octane number of leaded gasoline upon the addition of methanol, we have asked a related organization to measure the octane values of 70# gasoline after the addition of methanol. The octane numbers of 70# gasoline with 10%, 15%, 20%, 25% and 30% methanol are 75, 75.6, 76.4, 77.2 and 78 respectively. These values are obviously higher than the octane value of 74 for pure 70# gasoline. These mixtures are even better for high compression ratio engines with better efficiencies and economics than pure gasoline.

3. Dynamometer tests

In order to evaluate the gasoline-methanol fuel mixtures, we have requested the research organization of the Department of Transportation to perform dynamometer tests on these fuel mixtures. The results are as follows:

(1) When the amount of methanol in the mixture is less than 20%, the fuel mixtures may be used in the engines and carburetors without any modification. When the amount exceeds 20%, there are obvious reductions in engine efficiencies and increases in fuel consumptions.

(2) Because of the higher octane values of gasoline-methanol mixtures as compared to pure gasoline, it is advantageous to increase the compression ratios of the engines.

(3) Based on dynamometer tests with "Liberation CA-10B" engines and on the analysis of the combined power and economics data, the best compression ratio for 20% methanol in gasoline fuel mixtures is about 6.4.

4. Exhaust gas analysis

It has been reported[1] that the addition of 15-30% methanol to gasoline can greatly improve the pollution to environment. However, others have

reported[10] that the exhaust gas from 85% gasoline-15% methanol mixture has higher aldehyde content as compared to pure gasoline. In order to study the effect of this type of fuel mixture on the environment, we have requested the Environmental Protection Agency to perform dynamometer tests on fuel mixtures with different methanol contents. They have measured the contents of NO_X, CH_2O and CH_3OH in the exhaust gas. (Other pollutants such as CO and hydrocarbons are not measured because of equipment limitations.) The test results have shown that NO_X concentration gradually decreases with higher methanol contents in the fuel mixture. Except for individual cases, concentration is lower as compared to pure gasoline. The concentrations are also lower than the Japanese exhaust gas standard of 1973 (2200 ppm) and are close to the 1980 Japanese standard (1390 ppm). From the viewpoint of NO_X as the only pollutant, then the use of fuel mixtures has no effect on environmental pollution. Formaldehyde contents of exhaust gases from fuel mixtures are several times higher as compared to pure gasoline. Formaldehyde content increases with methanol content in the fuel. These results are in basic agreement with previous reports in the literature. Furthermore, the Environmental Protection Section of the factory have monitored the air composition at the driver's seat and the nearby atmosphere for three types of automobiles. The measurements near the driver's seat have indicated that the NO_X content for 30% methanol fuel mixture is lower than the permitted level for residential districts. Except for the "Liberation" which has a formaldehyde content slightly higher than the residential districts, the formaldehyde content for the other two vehicles is lower than the permissible level. Methanol concentrations exceed the permissible levels for residential districts, but is still lower than the concentrations in garages. The levels have also been monitored in the atmospheres near the tailpipe exit (20 cm. for Beijing Jeep, 120 cm. for "Liberation" and "East Wind" automobiles). Although the sampling point is quite close to the tailpipe exit, the NO_X, formaldehyde and methanol levels are still lower than the permissible levels in garages. For a moving automobile, there is natural diffusion of the exhaust gases into the atmosphere and the pollutants would be dispersed. There should be no noticeable effect on environmental pollution.

IV. Road Tests

Dynamometer test results have indicated that gasoline-methanol fuel mixtures have favorable characteristics. However, these results should be verified with actual road testing. Therefore, starting from last November, we have carried out long-term road tests with fuel mixtures containing 10-30% methanol on three types of automobiles: Liberation, East Wind and Beijing Jeep. Comparisons of results over a one-year period are as follows:

(1) The power and economic characteristics of mixed fuels with 10-30% methanol are close to or superior to pure gasoline. Gasoline consumptions per 100 kilometers are slightly lower than the national standard values on the average.

(2) The fuel mixtures have better antiknock characteristics than gasoline.

(3) Exhaust gases also cause less environmental pollution.

(4) Starting is easy. There are no troubles such as vapor locks. T' overall result if quite satisfactory.

As we have mentioned previously, the characteristics of gasoline-methanol fuel mixtures and pure gasoline are somewhat different. At present, all gasoline engines produced in China are designed specially to suit the characteristics of gasoline. For the fuel mixtures, certain modifications in fuel and electrical systems are necessary to optimize the results.

In our road tests, in addition to the combustions of fuel mixtures, we have also tested the mixed combustions of gasoline and methanol from separate tanks. The test results have shown that the latter procedure has advantages and may be used year around not effected by the weather.

V. Economic Evaluation

From the results of the dynamometer and road tests, we may give a preliminary evaluation for the economics of gasoline-methanol fuel mixtures. The price of methanol is $750 per ton. The price of gasoline is $728 per ton. The price of methanol is slightly higher by $22 per ton. Road tests with the fuel mixtures have shown that fuel consumptions are slightly lower than the national standards for three types of automobiles. The fuel consumptions for fuel mixtures and for gasoline are quite close. We have not added any other component to our fuel mixtures. Therefore, the cost of using fuel mixtures is only slightly higher than pure gasoline, thus it is feasible economically to use fuel mixtures. From another point of view, the use of fuel mixtures would save previous petroleum. For a Liberation driven over 50,000 kilometers at the national standard gasoline mileage, the use of 30 percent methanol mixture would save 3,150 kilograms of gasoline. Tremendous amounts of gasoline may be saved if all automobiles would use fuel mixtures. This has important consequences in the development of the society and the economics of our people.

VI. Special Problems Associated With the Use of Fuel Mixtures

1. The problem of layer separation

In the use of gasoline-methanol mixed fuels, not only we require a fixed amount for methanol (20-30%), but also there must be no separations into layers for all four seasons of the year. Special attentions should be paid to the following:

(1) Effect of temperature: As we have mentioned previously, there are large temperature effects on the miscibility between methanol and gasoline. In practical applications, special attentions should be

given to weather changes in order to avoid layer separations and their detrimental effects. In winters, the fuel mixtures should be heated if necessary and should be thermally insulated. The heating may be done by utilizing the exhaust gases or hot waters from the radiator of the automobile itself. An alternative is the use of separate tanks for methanol and gasoline and the use of mixed combustion.

(2) Effect of moisture: Gasoline-methanol mixtures have high affinity for water and low moisture resistance. If no special precautions are taken, then there would be layer separations even in summer (over 30°C) when the moisture content exceeds the allowed value. Thus we have to be careful with the preparation, storage and use of these fuel mixtures and we have to prevent moisture pickups which may cause layer separations.

(3) Additional components: Test results have shown that at low temperatures (such as in winter), additional components not only can improve the miscibility between methanol and gasoline, but can also improve the moisture resistance. However, these additional components are usually more expensive. For example, the costs are $2,400 per ton for n-butanol and $1,800 per ton for acetone, about 3.3 and 2.5 times more expensive than gasoline. Thus we must consider the economy carefully in order to decide about these additional components.

2. Vapor Lock Problems

Addition of methanol changes the distillation curves of gasoline. When 20% methanol has been added to gasoline, the 20% distillation temperature decreases by 15°C or more, the vapor pressure increases by about 0.8 kg/cm^2. There would be more vapor locks when mixed fuels are used as compared to pure gasoline. For practical applications, the fuel pump should be moved to a location not effected by engine heat.

3. Cold Start Problems

Because of the higher heat of vaporization of methanol (288 Kcal./kg.), the cold starting ability is poor. Pure methanol would cause cold starting problems. However, the heat of vaporization of gasoline at 88 Kcal./kg. is considerably lower and the cold starting ability is also much better than methanol. Even for the fuel mixtures containing 20-30% methanol, the effects on cold starting abilities are not too serious.

4. Air/Fuel Ratio

The theoretical amount of air is 14.8 kg. for 1 kg. of gasoline, thus the air/fuel ratio is about 16:1. Methanol is different from gasoline in having a high oxygen content (49.9% by weight); the theoretical amount of air is 6.5 kg. per kg. of methanol. Thus the fuel mixtures would require slightly less amounts of air as compared to pure gasoline, and it is necessary to

select the proper air/fuel ratio for a particular composition so that the combustion of the fuel would be complete. Preliminary calculations have shown that with properly controlled air/fuel ratios, the heat lost through the exhaust gas would be reduced by about 20% for fuel mixtures as compared to pure gasoline with resultant improvements in the thermal efficiencies of the engines. The economics of fuel mixtures is enhanced.

5. Problems of safety

Like gasoline, methanol is a combustible material with specific toxicities and can form explosive mixtures. Special attentions should be paid to these characteristics. In practical applications, safety precautions should be taken strictly; leaks and drippings should be avoided.

6. Problems for the use of fuel mixtures

According to the characteristics of various types of automobiles, different compositions of fuel mixtures and different compression ratios may be selected, the fuel and electric systems should be optimized. In the use of fuel mixtures, special attention should be given to the temperature effects of these mixtures. Objectives can be reached only by the proper operations.

7. Other problems

Pure methanol may dissolve or swell plastics, rubber and leather products. In the presence of moisture, pure methanol may corrode aluminum, magnesium, copper, steel and other metal products. Attention should be paid to these effects. Methanol-resistant materials such as teflon should be used for the crucial parts.

After long term road testing, no abnormal corrosions have been found for the engine pistons. Furthermore, there have been great reductions in carbon deposits in engine combustion chambers. The engine operations have remained normal.

Conclusions

1. The characteristics of gasoline-methanol fuel mixtures are similar to pure gasoline. The power and economical characteristics are close to or superior to pure gasoline. The fuel mixtures may be used for automobiles.

2. The fuel mixtures have higher octane number and better antiknock properties as compared to pure gasoline and are even more suitable for higher compression engines.

3. Compared to pure gasoline, the exhaust gases from using fuel mixtures have lower NO_X contents and slightly higher formaldehyde contents. The formaldehyde content is less than the permitted levels in garagaes. The use of these fuel mixtures would not cause much environmental pollution.

4. From the overall points of view of power, economy, environmental pollution from exhaust gases, etc., fuel mixtures containing about 20% methanol are suitable. The recommended compression ratios are ϵ = 6.4:1 or above for the engines.

5. Moistures and temperatures have large effects on the fuel mixtures. In winters, fuels should be heated and thermally insulated in order to prevent layer separations. During preparation, storage and usage, special attentions should be paid to the dryness of the equipments and containers in order to prevent contaminations by moisture from the atmosphere.

6. Two modes of usages of fuel mixtures may be considered: Combustions of mixed fuels or mixed combustions of fuels from separate tanks. The second mode is better because it is not effected by temperature or moisture limitations.

7. It is not necessary to add another component to gasoline-methanol fuel mixtures. This is important for the economics and for practical applications.

REFERENCES

1. Hydrocarbon Processing, 1980, 59, No. 2, 72-75.

2. Chemical Technology and Design for Natural Gas, 1977, No. 2, 9-10. (In Chinese)

3. Europ Chem News, 1975, No. 4, 28.

4. Chemical Technology and Design for Natural Gas, 1976, No. 4, 28.

5. Szechuan Fiber Technology, 1980, No. 7, 42-47. (In Chinese)

6. Oil and Gas J., 1978, 76, No. 46, 205-212.

7. Hydrocarbon Processing, 1979, 58, No. 5, 127-138.

8. Hydrocarbon Processing, 1980, 59, No. 11, 295-299.

9. Theory and Design of Internal Combustion Engines, Vol. 1, Machinery Industry Publishers, 1975.

10. Petrochemical Technology, 1981, No. 6.

Note: Additional information may be obtained by directly contacting Szechuan Fiber Factory.

9899
CSO: 4013/101

- END -

END OF FICHE DATE FILMED

NOV. 1 1982